VOL. XIX. No. 8 AUGUST 1934

MECCANO MAGAZINE

A SOUTHERN TRADER
(see page 602)

6D.



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NEXT MONTH: "WORLD'S GREATEST UNDERWATER TUNNEL." PUBLISHING DATE: 1st SEPTEMBER

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With the Editor

A Pioneer of the Modern Loom

On the 7th of this month occurs the centenary of the death of Jean Marie Jacquard, the inventor of the loom known by his name. Jacquard's career illustrates well the amazing changes of fortune that marked the lives of many of the inventive geniuses who laid the foundations of modern industry. He lived in dire poverty while striving to give practical effect to his ideas, and when at last success was within his grasp he met with opposition of such violence as to threaten complete and final ruin.

Jacquard was born in 1752 at Lyons, the home of the silk industry, his father being a silk weaver. Little is known of his early life, except that from boyhood he was keenly interested in machines. On the death of his father he inherited two looms, and these were quickly sacrificed in order to provide funds to develop his ideas for the production of a loom of an improved type. His experiments proved unsuccessful, however, and he was compelled to become a lime burner in order to earn a living. After a time he was able to resume his experiments, and eventually he succeeded in producing a loom that was far simpler and easier to work than the slow and heavy machines then in use. Soon afterwards his troubles began. The workmen in the factories of Lyons believed that the introduction of Jacquard's loom would cause them to be thrown out of work, and they smashed up the looms he had set up and compelled him to fly for his very life.

Persecution of this kind was experienced by many of the pioneers of textile machinery, but here, as in every other case it failed to achieve its object. The value of Jacquard's invention soon became realised by the silk manufacturers, and slowly but surely the loom found its way into general use. Jacquard never reaped much financial reward for his work, but in 1819 he was honoured by the award of the decoration of the Legion of Honour. Twenty years later his fellow citizens of Lyons woke up to the fact that he was a great man and had poured millions of francs into their pockets, and decided to erect to him a statue in bronze. The statue was duly completed, but by that time Jacquard was dead.



Jean Marie Jacquard (1752–1834) the inventor of the modern pattern loom.

The First Great Woman Scientist

The death on 4th July last of Madame Curie at the age of 66 brought to an end the brilliant career of the greatest woman scientist the world has yet seen. In 1898, in association with her husband Pierre Curie, Madame Curie discovered radium, the wonderful radio-active element that opened up a new era in science, and brought hope to millions suffering from cancer and other dread diseases.

Madame Curie was born in Warsaw, where her father was a teacher of science. In her early womanhood she went to Paris where, in spite of being friendless and unknown, she secured admission to the Sorbonne to study science. Her admission was in itself a remarkable fact, for in those days the presence of women in Universities was not encouraged. It is said that she first met Pierre Curie at a meeting, where he read a paper in the course of which it was asserted that women of genius were rare, and that the average woman was a hindrance to the serious scientist!

A Triumph of Patience

Apparently Curie was quickly convinced that his new acquaintance from Poland was a woman of genius. Very soon he married her, and for many years they worked together in perfect co-operation. The story of how they revealed radium to the world is a remarkable one. In 1895 Röntgen had discovered X-rays, and shortly afterwards another French scientist Henri Becquerel had found that the compounds of a rare metal named uranium also gave off mysterious rays that affected a photographic plate even if it were wrapped in black paper. The Curies decided to look for other materials that behaved in the same manner, and they made the remarkable discovery that certain specimens of pitchblende, the mineral from which uranium was obtained, were more active than the metal itself. They realised that some other substance lurking in the pitchblende must be responsible for this, and with infinite care and patience they set to work to track it down. To their delight and amazement they discovered not one but two new elements, both of which are radio-active. To one of these they gave the name polonium, in honour of Madame Curie's native country, and the other they called radium, because it possesses to an astonishing degree the power of giving off certain rays. Some idea of the care and patience necessary in this work is revealed by the fact that a ton of the pitchblende with which they worked contained less than 1/100 oz. of radium, and that in it this element is 10,000 times more abundant than polonium!

The use of radium in the cure of cancer and similar diseases is said to have been suggested as the result of Madame Curie presenting to Becquerel a glass tube containing an extremely small quantity of the substance. Becquerel kept it in his waistcoat pocket, and after a time noticed a tiny burn on his skin. This burn was traced to the effect of rays emitted by the radium. Later it was discovered that these rays destroy cancer cells.

In spite of her great achievements and world-wide fame Madame Curie was a retiring and rather frail little woman. The high estimation in which she was held was shown in 1906 when she was appointed Professor of Physics at the Sorbonne, Paris, in succession to her husband who had been killed in a street accident. Even more striking was the award to her of two Nobel prizes, a distinction that she alone has gained. A special laboratory, known as the Curie Institute, was built for her in Paris, and there she continued her research work almost to the day of her death. Fortunately her work will not be brought to an end, for it is being continued in the Institute by one of her two daughters who for many years has shared in her labours.

Windjammer Days

Some Memories of a Square-Rigger

By Roland Barker

"STAND by t'gallant halliards! Haul the crojik and mains'l up! Lee fore brace!"—More than twenty years ago I heard these commands rising above the roar of foaming greybeards and the howl of a Cape Horn squall.

I have dim recollections of the men of the ship "*British Isles*"—of Mr. Roberts, the mate, a big man with a heavy beard; of Mr. Evans, the second mate, a doughty little Welshman; of the young apprentices and hard-bitten foremast hands. I can still hear the echoes of their voices whispering through the mists of time.

The "*British Isles*" was launched from the ways of John Reid's yard on the banks of the Clyde in 1884. The vessel's construction and outfit embodied the most up-to-date improvements; her after cabin quarters were designed to afford a maximum of comfort; and from stem-head to stern post she was a thing of graceful symmetry. She was built of steel at a cost of £21 per ton.

In addition to being the biggest vessel of her type ever launched from Clyde shipyards, the "*British Isles*," when running with a free wind, was as swift as any ship afloat at that time. Her main yard measured 103 ft. in length from plug to plug, and her total sail area was enormous.

My parents took me aboard the "*British Isles*" when I was a child. The vessel was lying in Limerick, and about to proceed to Port Talbot on the Bristol Channel to load a cargo of Admiralty coal for Callao. I well remember that day, even unto my first meal in her spacious cabin. There was a little Cantonese steward named Wo Ken who set before me a dish of bacon and eggs. He seemed to take a great delight in watching me load myself down to my Plimsoll.

"What you likee, missy?" he asked my mother. "You likee tea, you likee kloffee? All lightee, me go fixee!" He was an old Chinaman then, with a greying pigtail and lustreless black eyes.

For the most part, my memories of the lordly "*British Isles*" unfold before me like the vision of a ship enshrouded in a slowly lifting fog. However, it is strange how trivial incidents relating to one's early environment become permanently stowed away in the mind, to be recalled at will with a clarity that mocks the intervening years. I remember that the saloon of the "*British Isles*" was beautifully designed and equipped. Round the mizzenmast, which was stepped through the dining table, was an armoury rack. It bristled with several braces of wooden-handled horse pistols and half a dozen shining cutlasses, which lent to the cabin a little touch of grimness.

One wintry day the capstan was manned and the anchor hove up, to the tune of a rousing chanty and the merry tinkling of the pawls. A "Jolliffe" tug steamed alongside, and not long afterwards we were towing out to sea. At my father's command, a towering cloud of white canvas was clapped on the vessel, and the tow line was let go. The vessel's speed increased: her wake began to boil and froth; and soon a sonorous snore could be heard from her lee bow wave.



The "Lancing," which started her career as a steamship and ended as a full-rigged sailing ship. The illustrations to this article are reproduced from the Editor's book, "The Romance of the Merchant Ship," by courtesy of the publishers, G. G. Harrap & Co. Ltd.

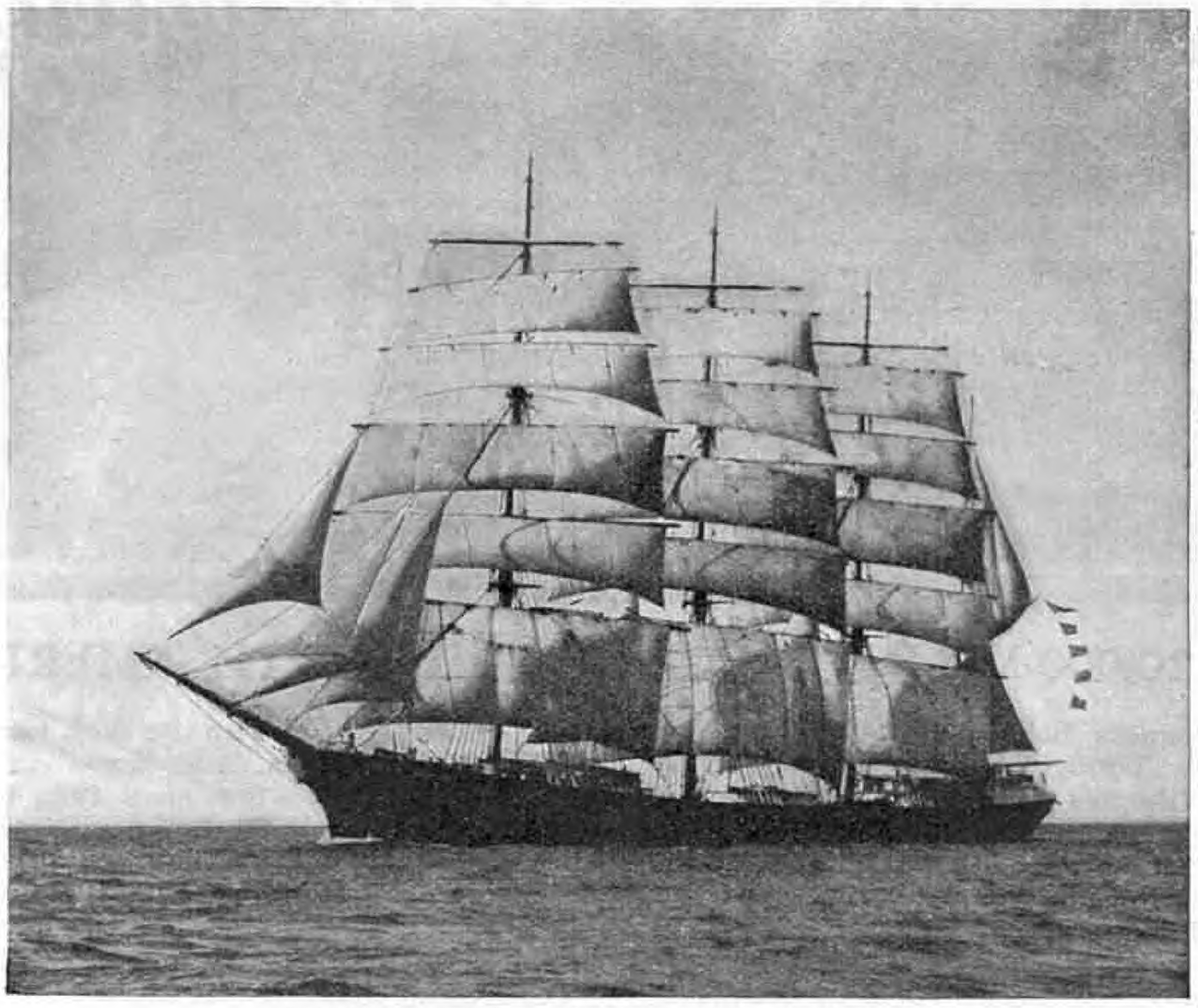
On the following morning my mother requested eggs for breakfast, and when none were forthcoming my father went on deck and hove the ship to. A few miles distant was the bleak coast of western Ireland. A lifeboat was swung out and lowered, and I remember going ashore with Mr. Roberts. We landed on a pebbly beach, near a white farmhouse with a thatched roof. We walked up to its low, oaken door, and the mate shouted like the blast of a Cape Horn snorter—"Ahoy there!"

An old, old woman opened the door then, and some chickens and a pig ran out of the house. She spoke Gaelic; but Mr. Roberts pointed to the chickens and made signs with his hands, all the while clucking in his beard. We bought a clothes-basketful of eggs. Then the lifeboat was launched again, and we set forth seaward. I insisted on attempting to ply a miniature oar that Aronberg the carpenter had made for me. The seamen in the boat grinned and winked; but as the mate was not inclined to tarry, he grabbed me by the collar and sat me down beside him in the stern sheets. When we drew alongside the ship, the precious eggs were hoisted safely aboard. The mate and I clambered up a rope ladder. Then, as the vessel rose and fell in the seaway, the men shinnied up the falls, and soon the lifeboat was again nestling on the skids.

My father, a terrible looking fellow with a brown beard and a huge, lion-like moustache, the ends of which tickled the lobes of his ears when he stood in the wind, walked to the break-of-the-poop and roared an order: "*Square the crojik yards!*" Under the mate's weather eye, the men jumped lively to obey, and with much lusty yo-hoing the yards were squared in before the fair wind. We filled away bound for the grey waters of the Bristol Channel. Off Valencia, however, we lay windbound for several days; but finally we arrived in Port

Talbot, where we loaded a full cargo of "black diamonds."

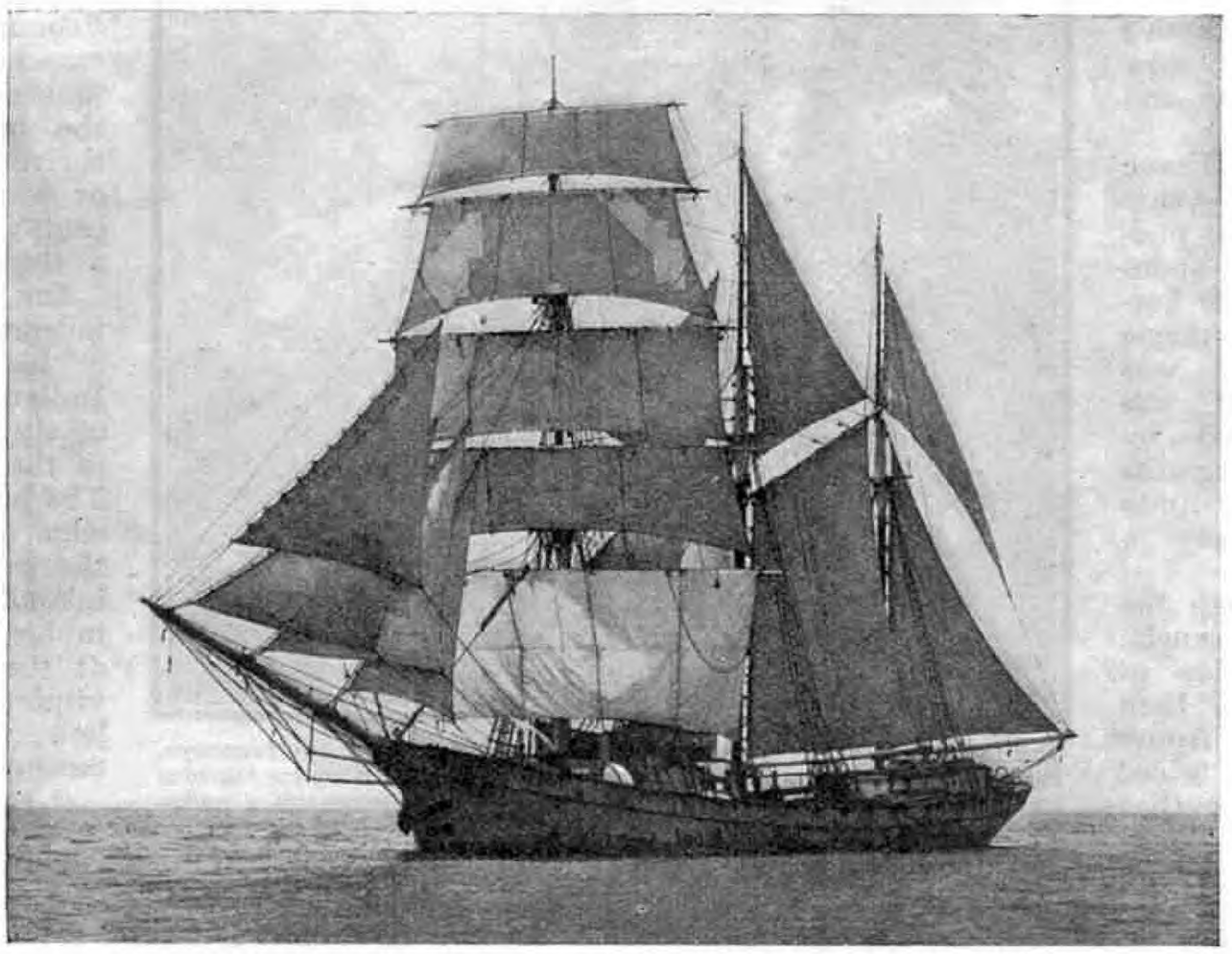
Then, at last, came the day when the "*British Isles*" began the long voyage to Callao. Ahead lay the boisterous Bay of Biscay; the calms of the Horse Latitudes; the nor'east trade belt with its steady sighing winds; the exasperating doldrums with their rains and light airs; Cape San Rocque, the bugbear of the Atlantic to all south-bound sailing ships; and the south-east trades.



The American four-masted barque "Golden Gate."

In due course the "*British Isles*" spanned those lonely ocean tracts. Every morning as she sailed to the south'ard my father would lash me to his back and take me aloft to the mizzen royal, while my mother, a pretty little dark haired woman, waited frantically on the poop-deck. "Look here, Peggy," he said to her on one occasion, "I want my son to get the smell of salt water in his nostrils." He wanted to make a sailor out of me, for in his opinion it was the only free life.

Father Neptune had focussed his lights on the family generations before my own father was born. My grandmother's twelve brothers had been born within a stone's throw of the sea on the storm lashed Island of Piel, which lies off the nor'west coast of England. One of them commanded an Indiaman; the others became masters and owners of the ships they sailed.



The British barquentine "Alaska," trading to the Ellis and Gilbert Islands.

Well do I remember a certain day when the "*British Isles*" was plunging her bowsprit into great cold seas that had begun to roll up from the foreshortened southern horizon. The weather was unsettled and gloomy. At dinner that day Mr. Roberts spilled a plate of soup in his lap. He muttered strange words in a gruff undertone; then, wagging his head solemnly, he spoke aloud: "Captain, if the wind comes out from the east, the weather will be dirtier than ever!"

"Mister, we'll soon have St. John's Point abeam," my father replied in a lighter vein, "and then, sir, with an east wind filling our sails, we could double Cape Horn and sail away to the west'ard like greased lightning!"

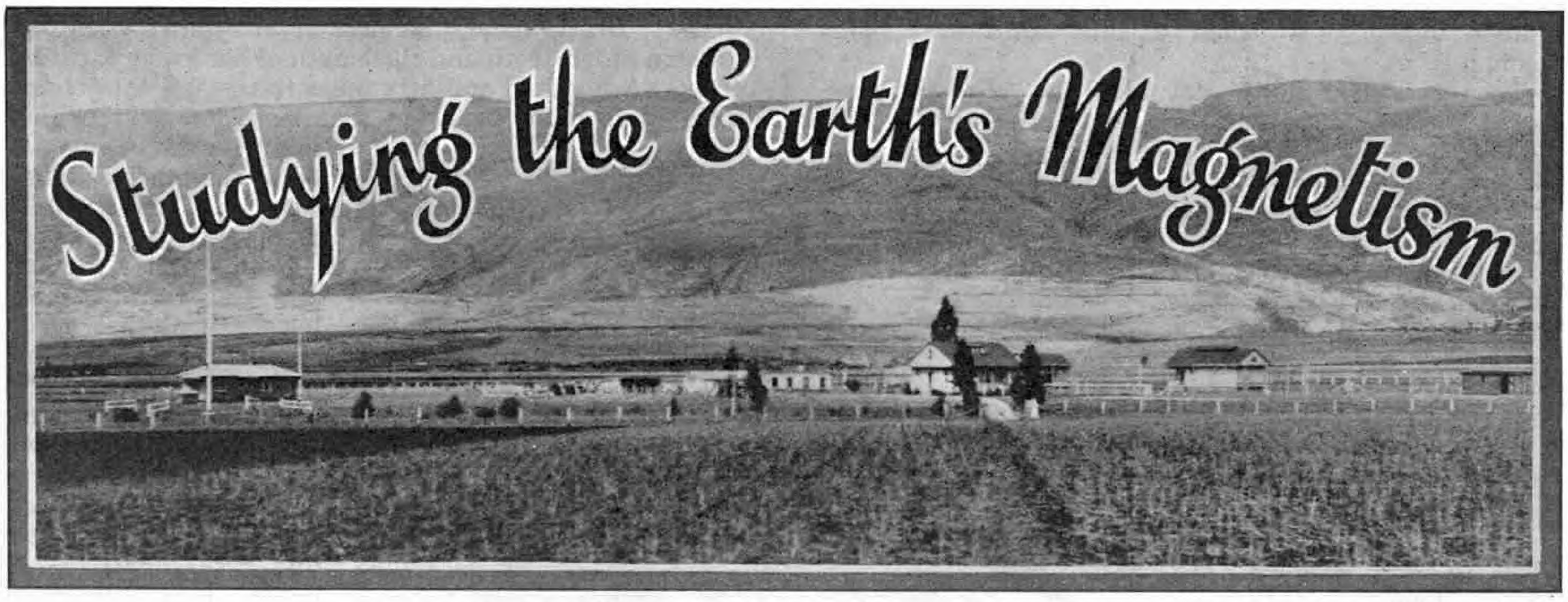
The "*British Isles*" weathered St. John's Point by the skin of her teeth and the length of her lower yardarm plugs. A hundred and fifty miles to the WSW lay Cape Horn, that gaunt headland that looks like a crouching lion. As the vessel sailed to the south'ard and west'ard, the mate's prophecy was fulfilled. The seas rolled higher, and the yawning hollows ran deeper than they had done to the nor'ard of St. John's Point. The winds began to screech and howl with increasing fury.

One day my father took me on deck to see my first albatross, a lonely bird breasting the gale between those wild Cape Horn seas and lowered, leaden skies. The ship was by-the-wind now under reduced canvas, struggling to make that precious westing which is the elusive aim of all outward bounders.

From that time on my mother and I remained below, for the vessel began to heave and roll in the grip of mighty seas. Sometimes I would climb upon the cabin settee and flatten my nose against a porthole; but only a scene of indescribable desolation would meet my eyes—great walls of grey water rushing madly to the eastward, their foaming crests staring threateningly down upon us as they licked the sullen, snow-charged sky. Often they would thunder aboard and fill the decks to the toprails. The ship would shake and shudder, the panelling of the cabin walls would groan and creak, and the shouts of oilskin-clad men clinging to the lifelines on the main deck would rise above the incessant whine of wind and driving spume.

All this my mother seemed to take as a matter of course. She heated Bovril and made steaming cups of cocoa for the apprentice boys who would knock timidly on the cabin door after having muzzled a thrashing tops'l in a Cape Horn snorter. Most of those same boys have continued to follow the sea through all the intervening years. Some of them became masters of liners; one was lost in the Great War when his ship was sunk by a German U-boat. What became of the

(*Continued on page 664*)



A 20,000-MILE TRIP THROUGH SOUTH AMERICA

IT is known that there is a magnetic field about the Earth that extends far out into space. Though discernible everywhere, the cause and origin of the Earth's magnetism are veiled in mystery. The Earth is not uniformly magnetised, neither is its outer crust or shell, 50 or more miles thick, uniform in its magnetic behaviour.

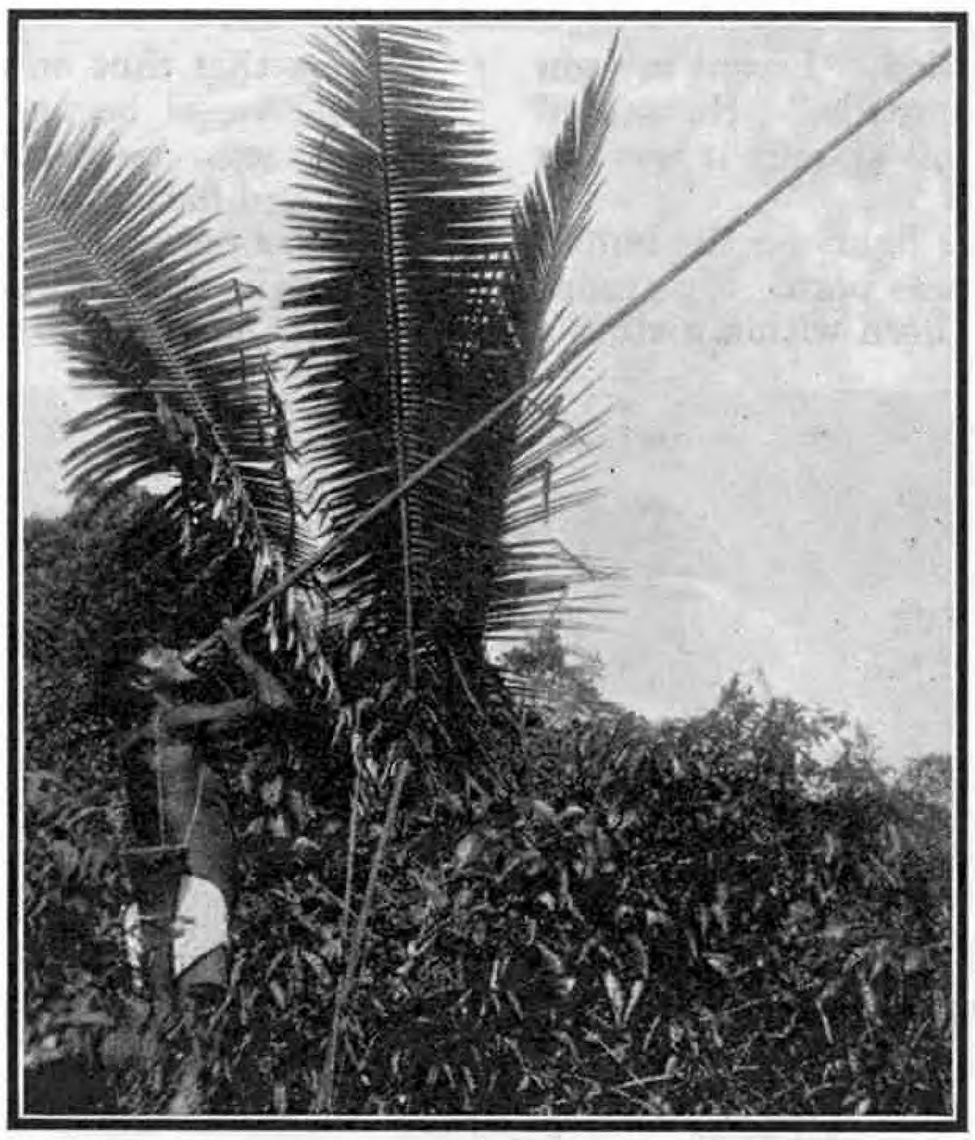
Study of the character and behaviour of the magnetic field calls for observations not only on the surface of our globe but also in its interior and in its atmosphere. This applies particularly to the higher atmospheric limits and to the Earth's enveloping skin or crust, where, apparently, we must look for explanations to account for the regular and irregular variations in the magnetic field which are constantly occurring. Obviously such study cannot be conducted entirely in the sheltered comfort of laboratories and observatories. Observations must be made in every nook and corner of the world before man can really know how the Earth's magnetism is distributed, and how it changes from day to day and from year to year.

Hundreds of expeditions have combed the world in recent years for information on magnetic phenomena. One of the many sponsored by the Department of Terrestrial Magnetism of the Carnegie Institution of Washington, was completed last year. This was undertaken and accomplished by Earl Hanson who, during 18 months of arduous travel, followed a route that would appeal to many a wandering adventurer.

His course took him through the West Indies and down to Venezuela, from Caracas to the oil-fields of Lake Maracaibo and return, then inland from Caracas to the Apure and Orinoco rivers and up the fabled Orinoco, first by sail-boat and then by dugout, straight to the heart of the jungles. The search for knowledge led him across the height of land to the Rio Negro, down to Manaos, and then up the Rio Branco to the vicinity of the British Guiana border. The Madeira River was covered, and the Rio Beni ascended into Eastern Bolivia. The Amazon was descended as far as Santarem, near its mouth, and ascended as far as Barranca, near the headwaters, over 2,000 miles away. Magnetic observations were made on the Huallaga River in Peru and along the northern trail to the coast in the half-forgotten Andes of Northern Peru.

At the Carnegie Institution's permanent magnetic observatory at Huancayo, in Central Peru, Hanson's instruments were checked and compared with those of the Observatory, and then his instructions led him up the West Coast into Ecuador and Colombia, inland to Bogota, and down the Magdalena River. Hanson carried with him the latest type of magnetometer, as well as a shelter-tent to protect the delicate instruments during use. In accordance with his instructions he erected this portable observatory at 86 points along his route for the purpose of making local studies.

But it was not always easy to carry out instructions that had been written in Washington. At times the jungle had to be cleared to make room for the tent, while tropical bogs in places rendered the work almost impossible. Gnats and mosquitoes pestered the scientist, and, in the more civilised centres, inquisitive school-children, cows, or goats denied him all privacy. Only too often does the glamorous adventure of scientific research involve not a little of monotonous drudgery.



The heading photograph shows the magnetic observatory at Huancayo, Peru, of the Carnegie Institution of Washington, to whom we are indebted for the illustrations to this article. In the lower photograph a native hunter is shooting a poisoned dart from a blowgun.

There were spots visited by Hanson where the sites mentioned in his instructions could not be found. Economic changes and the encroachment of the avid tropical jungles had seen to that, for in the hinterlands of South America thriving communities can be created or completely wiped out by a few cents' rise or fall in the price of a single commodity.

One of many experiences on the journey will illustrate this. Hanson, in his heavy dugout carrying five Indian paddlers, pulled up at one of the banks of the Atabapo River, in the heart of Southern Venezuela. The jungle came down to the water's edge and only with difficulty could the passenger penetrate a few yards inland. He scanned a small map in his hand, and looked about him at the trees of what seemed to be virgin forest, and at the vines and lianas that matted the spaces between them.

"There was a village here once," he said. "It was called Baltazar."

One of the younger Indians answered. "The old Jesuits built many villages, señor. They have now been lost and long forgotten."

"But this one existed in 1913. It had a plaza then, and a church, and many people."

"I remember it," said one of the older Indians. "It was farther upstream."

"It was farther downstream," commented another of the older men. "I carried rubber there in the days when Funes ruled our country."

A search for the site was begun on a 10-mile front, and, eventually one small broken mirror was found—the only trace of what less than 20 years before had been a thriving townsite, with a plaza, church and many people.

The expedition laboured slowly upstream from Baltazar for several more days to the famous Yavita-Pimichin Portage, which was crossed on foot. This Portage—now a jungle trail for local Indians and entirely abandoned except by monkeys and parrots—was an important highway for centuries. It is now all but impassable because of the entangling vines that hang across it, the low muddy collections of the season's rains, and the great trees that have fallen over the way.

From the deserted settlement of Pimichin the party paddled down the Pimichin River where, a few days before, advance scouts had drifted on a balsa-wood raft in order to return with a canoe for the traveller's use. Many days later, after having paid a passing visit to the tranquil Indian village of Maroa, the expedition drew ashore at the town of San Carlos, where there are still a few white men.



The Expedition's pack train approaching one of the numerous covered bridges in the Peruvian Andes.

These were intensely interested in the activities of their visitor, who set up his tent in the plaza and spent several days in it, working with strange instruments. He spent his evenings in the house that had been assigned him, doing queer things with logarithmic tables and mathematical formulæ. His only commercial interest seemed to be the attempts he made, largely unsuccessful, to buy fresh food—chickens, bananas, vegetables—to enable him and his men to descend the Rio Negro as far as the Amazon.

His business was guessed at as being anything from that of a weather prophet to that of a scientific rubber scout. But the view, logically arrived at, that he was looking for the treasure that the Jesuits had hidden somewhere about a century and a half before, was the one finally accepted.

Before he left Hanson buried a stone with a cross on it to mark the place where he had been working. But before he had been gone a week, the stone was dug up to see what might be found underneath it!

And so, first because of the jungle itself, and then through the curiosity of the men who are still able to hold out against the jungle, were lost two more of the thousands of marking stones that in recent years have been planted over all the world in the interests of this branch of science. Indeed, Hanson was looking for treasure, but not the kind that the Jesuits left. He was looking for scientific data, painfully acquired and mailed to Washington, guarded and studied there as small bits of grist for the mill that so ceaselessly takes the raw materials of facts and turns them out into orderly, useful knowledge.



Map showing the route taken by the Expedition during its 20,000-mile trip through South America.

Hanson's task was to make "absolute observations" of magnetic declination, inclination, and intensity, the first being the deviation of the Earth's lines of magnetic field from true north, the second being their angle from the horizontal in the vertical plane, and the third being the strength (intensity) of the field.

The results obtained are being studied in Washington to-day with a view to determining the present "secular" or annual variation in these three elements in the regions traversed. For, at nearly every point where Hanson made observation, he had been preceded, anywhere from five to 23 years before, by at least one other scientist who had made similar observations. Thus Power had preceded him to Baltazar on the Atabapo River, and Howard and a number of others to Manaos on the Amazon. From the differences between the previous and the present observations, the amounts of change in values are computed.

So exacting is this work, of which the whole wide world is the laboratory, that the observer was required, wherever humanly possible, to reoccupy within the nearest inch the spot used by his predecessors. Markers had been left by all the previous observers, as they have been left in all parts of the world, from the heart of Africa to the Tibetan plateau; but Hanson also carried sketch-maps and detailed descriptions of stations to effect recovery of sites despite local superstitions and the ever-present treasure-legend. And he himself prepared markers, descriptions, and maps, for the guidance of his successors.

The total mileage of the expedition, covered by steamer and launch, sail-boat and dug-out, railway, aeroplane, and auto truck, by mule cart, on foot, and in the saddle, amounted to 20,285 miles.

To the average layman, the variations of the Earth's field of magnetism come as a surprise. He knows that the compass seldom points true north, but believes that it always points to one of two magnetic poles on the surface of the Earth. He seldom knows that there are several local poles besides these two, caused by the presence of magnetic materials near the surface. He is wrong in thinking that the compass always points to one of the two that he knows of.

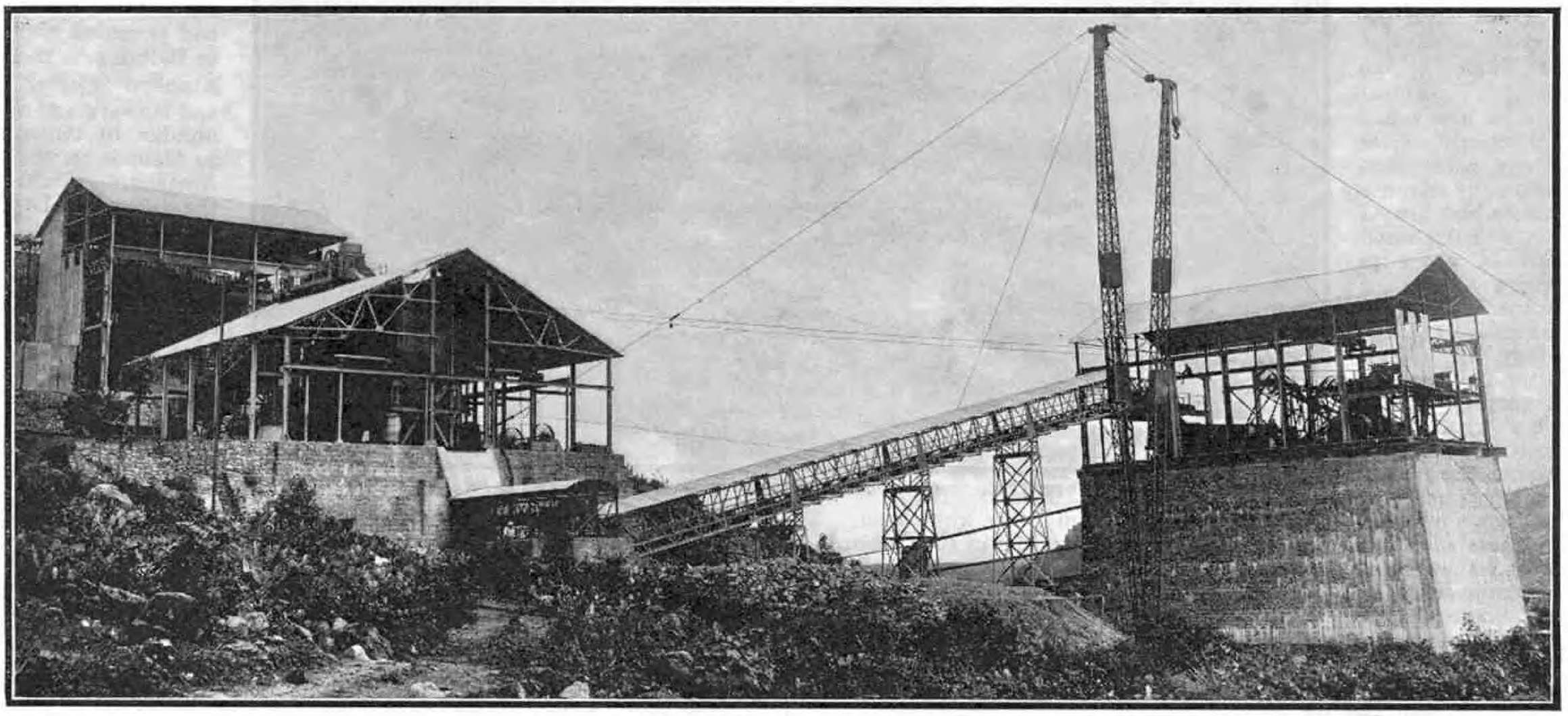
If he followed the needle long enough he would eventually get to a pole, but over a zigzag route. He does not know that the nature of this route changes from year to year and even from hour to hour between morning and night, as the declination at each spot on the surface of the Earth undergoes its "secular" variations for causes unknown, and its "diurnal" variations that are probably due to the influence of the Sun.

He does not realise that on the calmest and most delightful day, a magnetic "storm" may be raging over the world, causing delicate measuring instruments to behave like rowboats in a gale.

But it is through the continued study of these phenomena, and of the variations in inclination and intensity as (*Continued on page 664*)

The World's Largest Dam

Irrigating the Cauvery Delta, in India



AN important feature of the development of Egypt and India has been the carrying out of immense irrigation schemes to make large areas of barren land fit for cultivation. In Egypt these works are necessary owing to the low level of the River Nile during the dry season, and in India on account of the scanty rainfall of the plains and the occasional failure of the north-east monsoon. In this article we shall describe a scheme of this nature just completed in India by the Madras Presidency to improve and extend the irrigation of the delta of the Cauvery River. This scheme will be officially inaugurated on the 21st of this month by His Excellency the Acting Viceroy, Sir George Stanley.

A plan for the irrigation of the Cauvery Delta by the storage of flood water was put forward as long ago as 1856, when it was proposed to construct a reservoir on the river near Neringipet. An alternative plan proposed to utilise the water of the important tributary, the Bhavani River, which has a catchment area of 2,480 sq. miles and a flow of about 70,000 million cu. ft. a year, by means of a dam 155 ft. high across the river, but the plan was rejected as this height was considered to be too great. Other Bhavani schemes were put forward from time to time, and it was not until 1901 that the Cauvery River again came into preference as the site for a huge reservoir.

The photograph above shows one of the three powerful stone crushing plants employed in the construction of the Metur Cauvery Dam, in India. Each plant had a normal output of 120 tons to 150 tons of screened and graded stone per hour, and if necessary could be run to give about 200 tons per hour. This illustration and the upper one on the opposite page are reproduced by courtesy of Hadfields Ltd., Sheffield.

Before dealing with the recently completed project and the engineering equipment used we will describe briefly the course of the Cauvery River. The river has its source in the Western Ghats, a range of mountains averaging about 4,000 ft. in height extending along the western coast of southern India, about 100 miles inland. The river begins at Bhagamandala, in the Coorg Province, and flowing more or less eastward it descends through Mysore State and other provinces to the Bay of Bengal. Metur, where the dam has been built, is 275 miles from the river source. About 25 miles below Metur the Cauvery is joined by the Bhavani River, and at the Upper Anicut, a regulating weir 110 miles below Metur, the Cauvery branches into two, the divergent waterway being known as the Coleroon River. The Upper Anicut enables flood water in the Cauvery to be passed into the Coleroon. Until 30 years ago the Upper Anicut was a solid masonry structure incorporating a bridge and a few low-level sluices. It was considerably altered during 1900-1903 to regulate more effectively the river flood. The low-level sluices were closed, the crest of the structure was lowered 4 ft., and huge shutters 40 ft. long and 6 ft. high, that can be raised clear of floods or lowered on to the crest, were installed.

The Cauvery and Coleroon rivers run more or less parallel, and 20 miles downstream they reach the Grand Anicut, a regulating weir across a channel connecting the rivers, that provides another flood water escape. At the Grand Anicut the Cauvery again branches into two, and the weir acts as a diversion, both the Cauvery and its branch, the Vennar River, being equipped with head regulators, heavy shutters that are raised or lowered from bridges across the respective branches. The regulators of the Grand Anicut control the irrigation of the Cauvery Delta system of about 895,000 acres, and another regulating weir, known as the Lower Coleroon Anicut and situated 70 miles below the Grand Anicut, controls the irrigation of a further 108,000 acres through a system of canals from the Coleroon River.

The Metur Cauvery project provides for the irrigation of 1,000,000 acres of existing rice crops in the delta of the river, and of 301,000 acres of new irrigation adjacent to the larger area just mentioned. It has involved the building of a dam 5,300 ft., or just over a mile, in length, and 176 ft. high above the average level of the river bed, that is the largest dam in the world. This dam has created a huge reservoir with a storage capacity of 93,500 million cu. ft. Other important work was the construction of a canal and branch waterways to irrigate the 301,000 acres. The reservoir will store the surplus flood water that results from the heavy rains brought by the south-west monsoon that blows periodically during the months April to October, and will distribute the water impartially to the delta during the other months, thus compensating for the occasional failure of the north-east monsoon.

Preliminary work on the project was started in December, 1924, in anticipation of the formal Government sanction which was given in March of the next year. Preparations for the construction of the dam were begun in 1926, when two camps to accommodate the engineers and the hundreds of native labourers engaged were established near the chosen site. In addition to the men's quarters the camps included stores, offices, churches

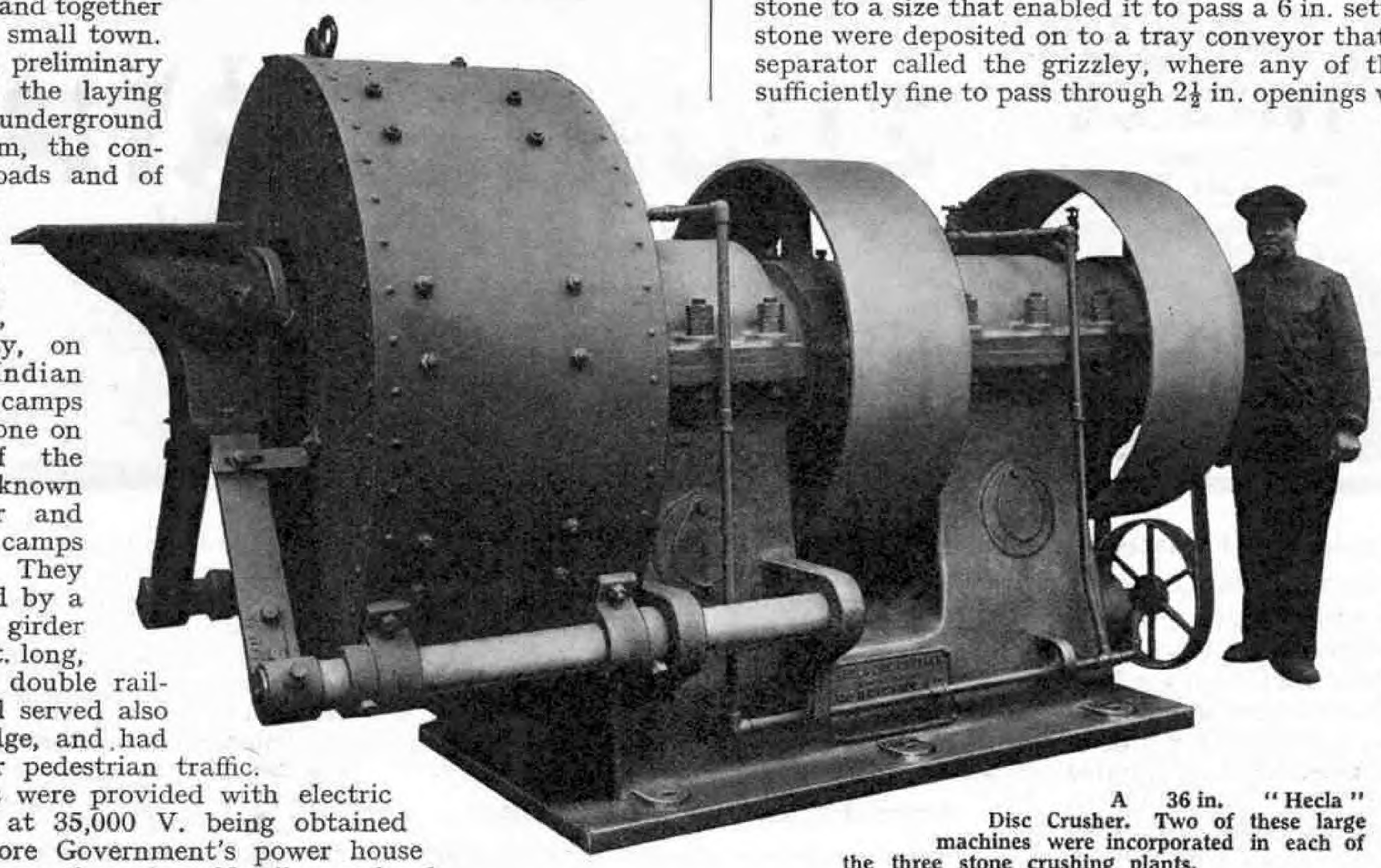
and a hospital, and together they formed a small town. Other essential preliminary tasks included the laying of an adequate underground drainage system, the construction of roads and of a broad gauge branch line connecting Metur with Salem Junction, 25 miles away, on the South Indian Railway. The camps were situated one on each side of the river, and were known as the Metur and Ellis Saddle camps respectively. They were connected by a 16-span plate girder bridge, 1,056 ft. long, that carried a double railway track and served also as a road bridge, and had a sidewalk for pedestrian traffic.

Both camps were provided with electric light, current at 35,000 V. being obtained from the Mysore Government's power house at Sivasamudram, through a 62-mile overhead transmission line erected across dense jungle country. The current was carried to a power house at Metur camp, where it was transformed to 3,300 V. This power house contained also five 105 h.p. compressors which, together with additional compressors elsewhere about the camp and connected to the main equipment, supplied the compressed air used for working the powerful rock drills, tools and winches, and the heavy gates of the stone-crushing and concreting plants.

We will describe first the building of the dam at Metur, the actual construction of which was commenced in July 1928. The dam is founded upon gneiss and charnockite rock which, in the river bed section, the contractors exposed by means of cofferdams. To prevent water from percolating into it through fissures in the river bed, a series of holes 20 ft. deep and 40 ft. apart were drilled and grouted under the front of the upstream face of the dam, and a similar series of 40 ft. holes, spaced the same distance apart, under the rear of the face. The extent of this protective work is shown by the fact that a total of 12,500 ft. of rock was drilled and 212 tons of cement used in the grouting operations. The front holes were subsequently built over, but the rear holes were continued upward behind the face by vertical drainage shafts that extend to the full height of the dam. The shafts are built of porous concrete blocks with a 1 ft. diameter hole through the centre. At almost one-third the height of the dam, and in the body of the structure, these shafts intercept a lengthwise drainage gallery 4,240 ft. long, 7 ft. 6 in. high and 7 ft. 6 in. wide. This gallery is sloped to its junctions with three transverse drainage outlets.

The method of construction of the dam was to build the face of rubble masonry and to make the body of concrete placed by means of concreting towers. In parts where the foundations are not very deep and the quantity of concrete to be placed at one time was uneconomical, rubble masonry was substituted for the concrete.

The concrete consists of crushed stone in cement, and the reduction of the stone to the required fineness for mixing was effected by three powerful stone crushing plants supplied by Hadfields Ltd., Sheffield. The order for these machines was the largest of its kind ever received in this country, and the 54 in. by 42 in. sledging jaw breakers with patent chain feeders are the biggest ever made in England for handling hard granite. The patent chain feed regulated the flow of the large material passed to the huge sledging breaker, and the latter reduced the stone to a size that enabled it to pass a 6 in. setting. The lumps of stone were deposited on to a tray conveyor that carried them to a separator called the grizzley, where any of the stone that was sufficiently fine to pass through 2½ in. openings was separated from the bulk, and was dropped on to belt conveyors. The conveyors discharged it to twin revolving screens 20 ft. long and 5 ft. in diameter, for sorting into the particular sizes that were desired to meet the conditions on the site.

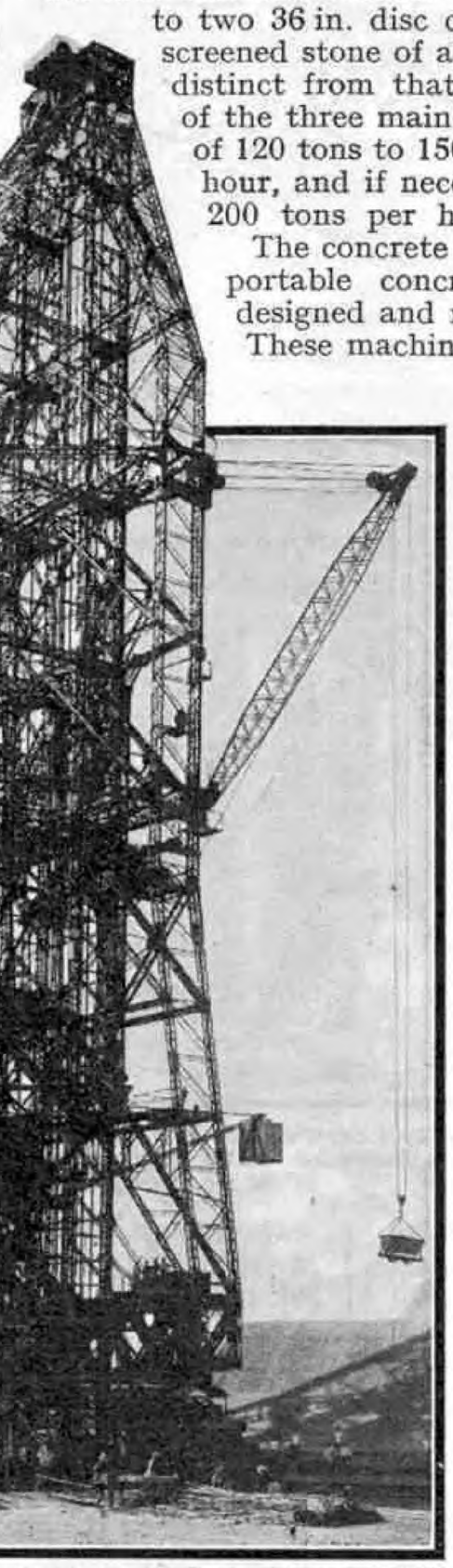


A 36 in. "Hecla" Disc Crusher. Two of these large machines were incorporated in each of the three stone crushing plants.

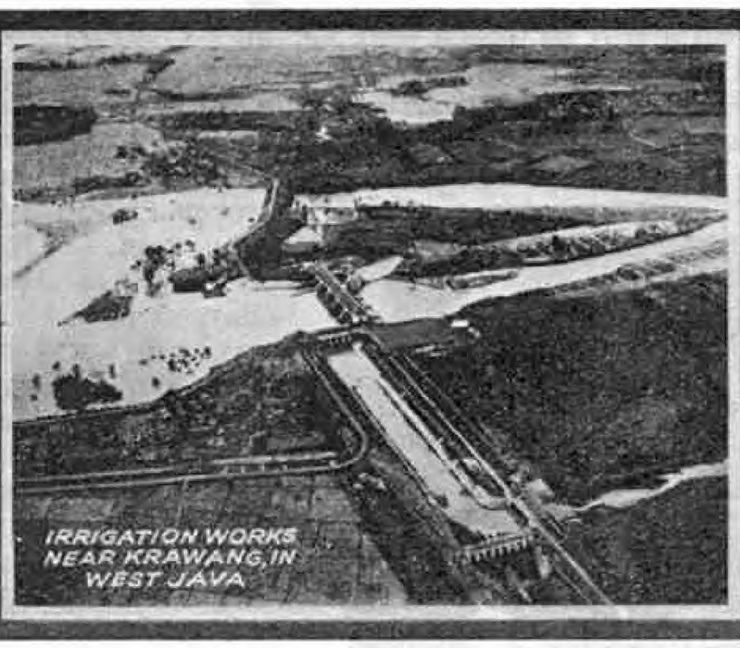
The bulk detained by the grizzley was deposited in a bin, and was fed from this as required to six secondary breakers, which had a mouth opening of 24 in. by 13 in. The whole of the crushed stone from these breakers was deposited on to the belt conveyors just mentioned. It followed the material abstracted by the grizzley through the screens, and all that was fine enough fell into bins underneath. The residue or "oversize" was elevated to two 36 in. disc crushers that further reduced it to unscreened stone of about 1¼ in. This fine material was kept distinct from that obtained from the main plant. Each of the three main plants was designed to give an output of 120 tons to 150 tons of screened and graded stone per hour, and if necessary they could be run to give about 200 tons per hour.

The concrete was mixed and poured by two massive portable concrete mixing and distributing towers designed and made by Stothert and Pitt Ltd., Bath. These machines are of particular interest, in view of the fact that they are the world's largest portable equipment designed for such work. Each tower was 284 ft. in height above the front rail and 302 ft. above the rear rail, and embodied storage hoppers of 500 tons' capacity and two concrete mixers having a combined mixed batch capacity of 4 cu. yds. The tower had an output of 166 tons of concrete per hour or 2,000 tons per working day of 12 hrs., and it could deliver the material to the full height of the dam, that is 155 ft. above or below rail level. The total weight of each tower, with the storage hoppers, mixers and chutes full of material, was approximately 1,820 tons. It was electrically operated throughout, and was supported on three travelling bogies, two on the front tracks and one on the rear. The centres of the bogies on the front rails were 80 ft. and the distance between the centres of the front and rear tracks was 80 ft. It is worthy of note that each tower was not only capable of travelling under its own power, but also could travel up a maximum slope of 1 in 20. Under the latter conditions the importance will be realised of keeping such a structure, some 300 ft. high, in a vertical position, and a special adjusting gear for this was embodied.

The aggregates were conveyed in tip wagons along the front tracks to the tower, where two traversers transferred the wagons from the tracks to hinged ramp girders slung from the tower. *(Cont. on page 680)*



One of the two massive concreting towers that mixed and poured the concrete for the Dam. These movable towers were 284 ft. in height above the front rail and were electrically operated. Photograph by courtesy of Stothert and Pitt Ltd., Bath.

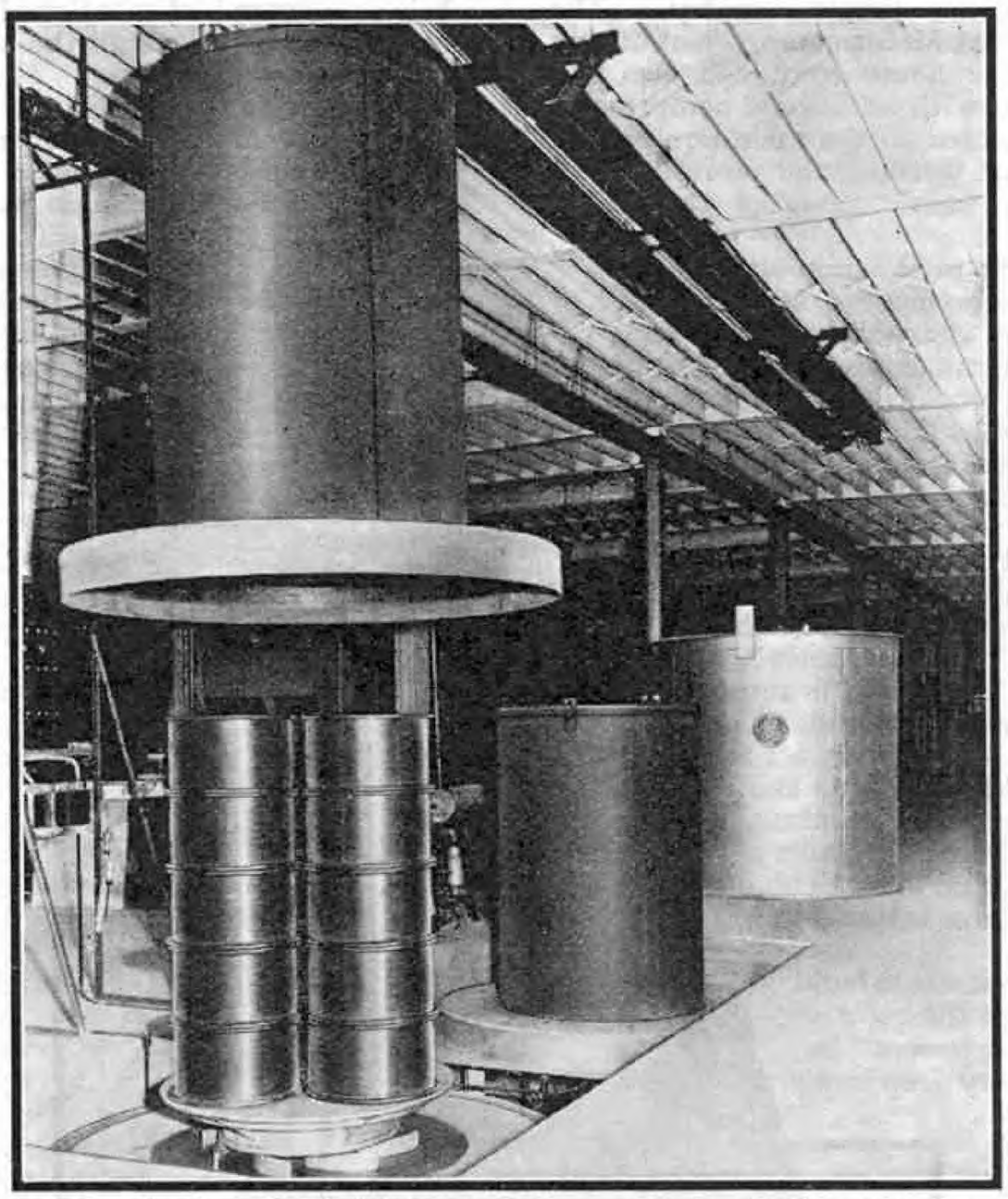


ENGINEERING NEWS

Protective Atmospheres in Furnaces

The use of protective atmospheres in furnaces to prevent oxidation, or to reduce oxide, is rapidly becoming standard practice, and great progress has been made both in the application of controlled atmosphere furnaces and in the equipment for processing available gases to make them suitable as protective atmospheres. An installation of controlled atmosphere furnace is shown in the illustration on this page. This furnace, which is for bright annealing copper wire wound on reels, is of the bell type with an inner hood placed over the charge, which consists of 15 reels each 22 in. in diameter loaded three per layer and five layers high, giving a total net charge of 7,500 lb. of copper. A protective atmosphere is maintained under the hood during the heating and cooling period. Several loading bases are provided, each equipped with a motor-driven fan that circulates the gas through the charge, and thus decreases the time required for both heating and cooling, and at the same time provides greater uniformity of temperature throughout the charge.

Another installation in which a protective atmosphere is used is shown in the upper illustration on the opposite page. This consists of a roller hearth furnace for annealing silicon steel strip continuously. The furnace comprises a horizontal heating chamber 32 ft. long by 44 in. wide, and a cooling chamber continuous with it. A roll table, consisting of driven rolls, extends the entire length of both chambers. The strip is drawn through the furnace from loose coils by a motor-driven pinch roll placed beyond the discharge end. The protective atmosphere is supplied by a General Electric atmosphere controller, combustion type, utilising natural gas burned under controlled conditions, giving a gas consisting of approximately 6 per cent. hydrogen, 6 per cent. carbon monoxide, and 6 per cent. carbon dioxide, and the balance nitrogen. Approximately 1,000 cu. ft. of gas per hour is required for the furnace, and this is obtained from about 150 cu. ft. of natural gas.



Bell type electric furnace for bright annealing copper wire in controlled atmosphere. This illustration and the upper one on the opposite page are reproduced by courtesy of the General Electric Company of New York.

Dutch Lifting Bridge

A large vertical lift bridge has been put into operation across the Oude-Meuse waterway, near Barendrecht, Holland. The bridge consists of two lattice-steel towers, one on each shore, supporting a lift span 221 ft. long which, when raised to its full height, provides a clearance of 133 ft. to shipping. The lift span is 446 tons in weight and is balanced by counterweights. The control room and machinery cabin are at the left-hand side of the bridge and are situated so that the operator has a clear view. The bridge carries a roadway 21½ ft. wide, and replaces an old structure that consisted of four fixed spans and a swing bridge.

Proposed Tunnel Through Mont Blanc

French engineers are now carrying out experiments to discover if it is possible for a vehicular tunnel to be driven through one of the shoulders of Mont Blanc. Such a tunnel would enable motorists to travel from Paris to Rome by the shortest possible route without going above an altitude of 4,000 ft. At present the Alps are crossed by way of the Mont Cenis Pass, but this route can only be followed during the summer, a detour along the coast by way of Nice and Monte Carlo being necessary in winter.

The route suggested for the Mont Blanc tunnel would make it a little less than eight miles in length, which is considerably shorter than the two railway tunnels that now pierce the Alps, but it is realised that many difficult engineering problems would have to be overcome. The most important of these are connected with ventilation and air conditioning, but they should not be insuperable, as experience in the removal of exhaust gases has been gained in many long tunnels. The greatest difficulty will be in controlling the temperature, for investigations that have been carried out show that in certain sections the temperature will be as high as 101°F.

A Dam to Cost £12,000,000

The construction of a new dam that is to be built across the Missouri River in Eastern Montana will take four years to complete and will cost nearly £12,000,000. The dam will impound a lake 174 miles in length with a shore line of more than 1,520 miles, and covering over 17 million acres of land now occupied by 300 ranches and two small settlements. The scheme will make a river channel 8 ft. or 9 ft. deep always available for navigation.

The electrical equipment for constructing the dam and dredging the river at the point where it is to be situated is being supplied by the General Electric Company of New York. It will include 21 main pump motors each developing 2,500 h.p., five cutter motors of 700 h.p., and five 150 h.p. winch motors, as well as the necessary control apparatus. The motors will be used to equip four dredgers, four floating "booster" electric power stations, and four land power stations. The dredgers will be employed by engineers of the United States Army, who are carrying out the work, to move about 1,325,000 tons of material from the bed of the upper Missouri River.

Two New Submarines

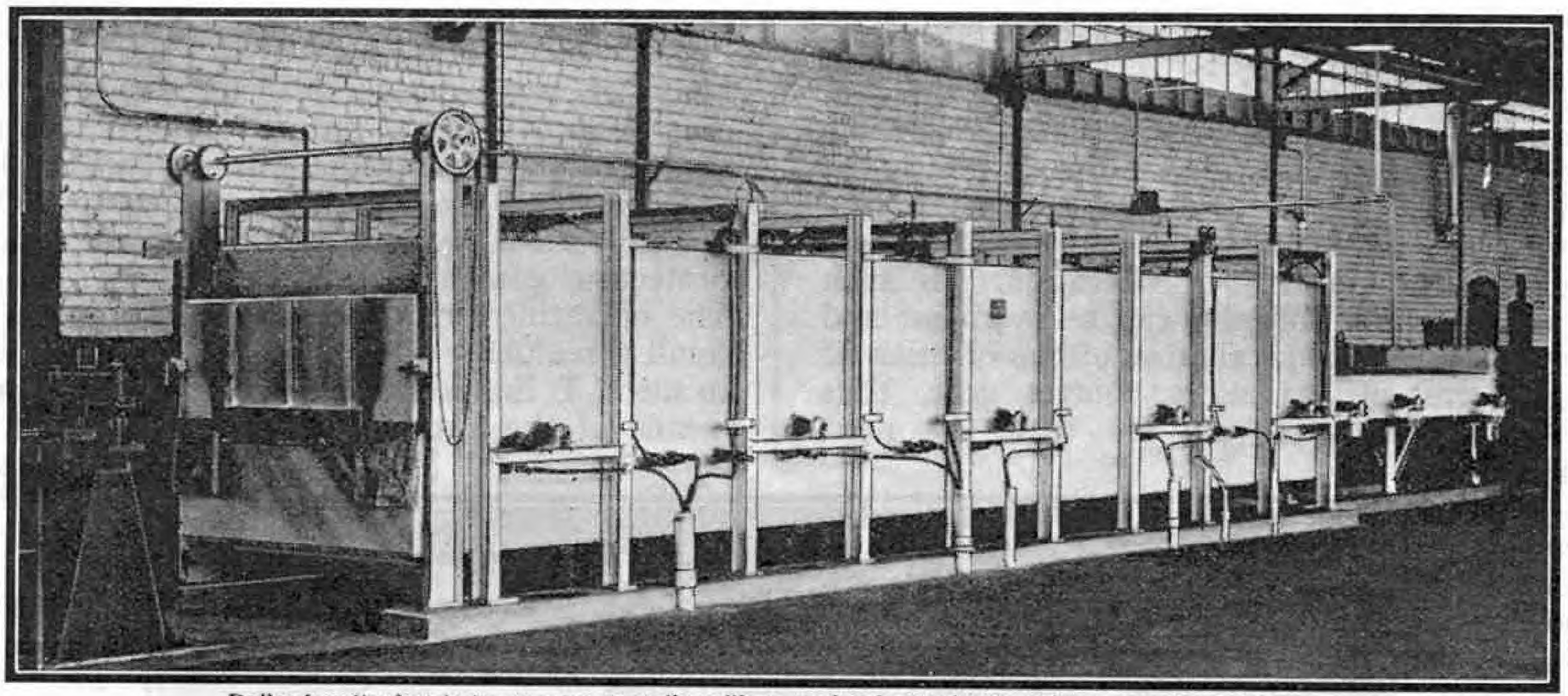
Two interesting submarines have recently been launched in this country, one for the British Admiralty, and the other for the Portuguese Navy. The British vessel was built at the Birkenhead yards of Cammell Laird and Co. Ltd., and is 193 ft. in length and 24 ft. in breadth. It has a surface displacement of 670 tons, but when entirely submerged it displaces 1,000 tons. It is capable of attaining a speed of about 13¾ knots when the engines develop 1,550 h.p.

The Portuguese submarine is named the "*Delfim*," and is the first of three vessels that have been ordered by the Portuguese

Government from Vickers-Armstrongs Ltd. It is interesting to note that the orders for the vessels were placed in Italy but were afterwards transferred to this country.

A Remarkable Welding Job

An unusual welding job was carried out a short time ago in Canada when an air compressor weighing some 6,000 lb. broke into 65 fragments and was completely repaired by welding the pieces together. The work was done without pre-heating the parts, the pieces beingjoined together one by one, each section being allowed to shrink before the work of joining the next one was begun. The work occupied a welder and a helper for only 15 hrs.



Roller hearth electric furnace for annealing silicon steel strip continuously in a protective atmosphere.

An Interesting Bucket Excavator

An interesting small bucket excavator has been produced that has a bucket of only $\frac{1}{4}$ cu. yd. capacity. In full working condition it has a total weight of $6\frac{3}{4}$ tons, and therefore is very suitable for use on soft ground, the actual pressure exerted by the caterpiller track being only 7 lb. per sq. in. The excavator is a product of Thomas Smith and Sons (Rodley) Ltd., of Rodley, near Leeds, and is small enough to be transported quickly by ordinary motor vehicle to any place where its services are required. In spite of its small size the machine is remarkably efficient, and during tests carried out with materials ranging from ordinary earth to stiff clay continuous outputs varying between 25 and 35 cu. ft. of spoil per hr. have been obtained.

The machine is of normal type and can be provided with engine units to run on heavy oil, petrol, or paraffin. It is designed to be capable of climbing a gradient of one in four, and it can be quickly and easily converted for use as a shovel, a skimmer, a trencher, a dragline excavator or a crane.

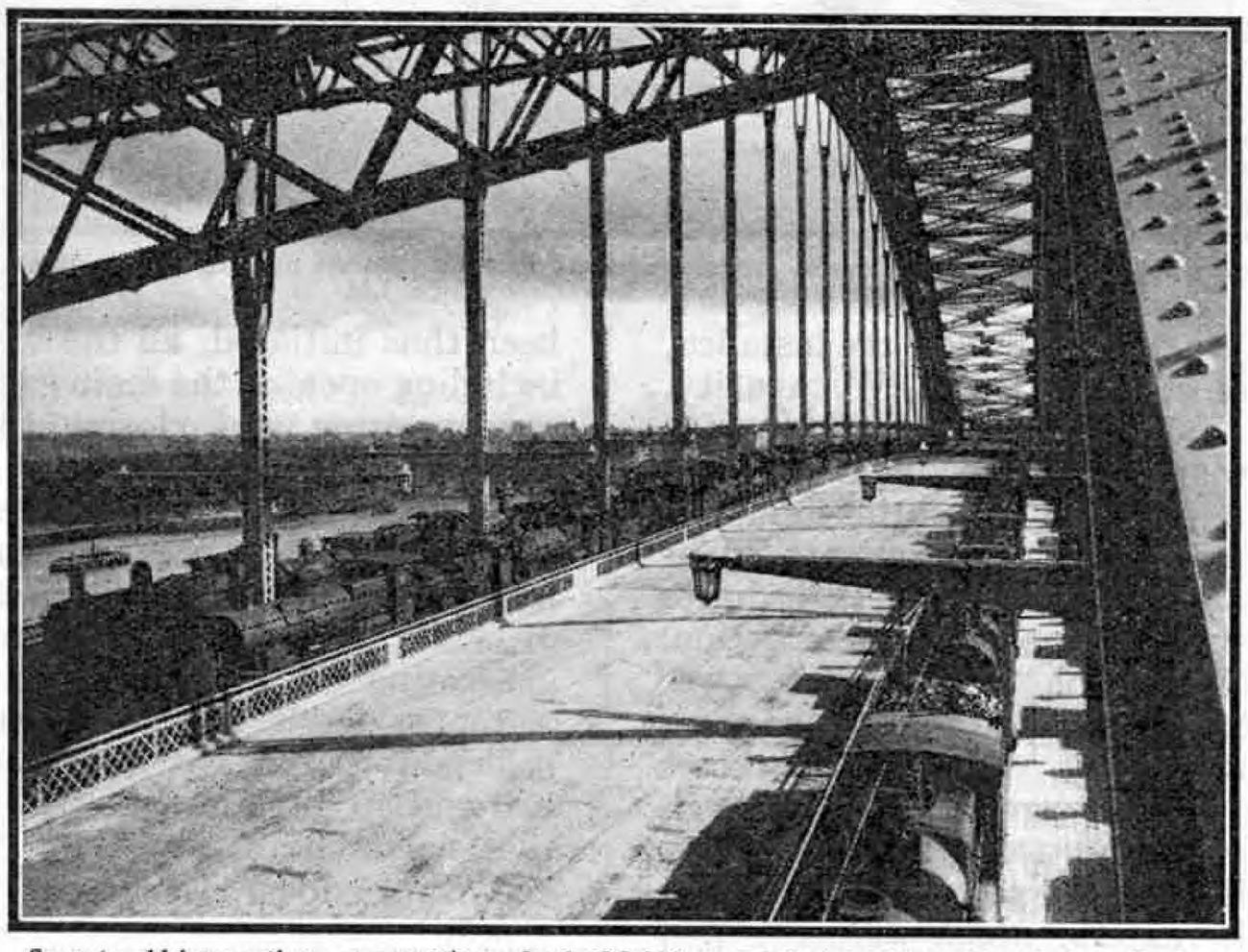
Lathe to Take Work 60 ft. in Length

A new heavy lathe capable of dealing with work 60 ft. in length between centres was used recently to machine a boiler drum for the Fulham Power Station. The drum was 45 ft. in length and $5\frac{1}{2}$ ft. in diameter, and had a total weight of 88 tons. This lathe is at the works of the English Steel Corporation, Openshaw, and is suitable for all kinds of machining.

The bed of the lathe is 86 ft. 8 in. long and 4 ft. wide, and has four saddles each provided with its own electric motor. In a machine of such a size the removal of chippings is quite a problem, and in this case it has been overcome by providing a conveyor along the centre line of the lathe that carries them to a container that can be removed as required by a shop crane. The face plate of the lathe measures 9 ft. 3 in. in diameter, and is provided with eight "dogs" moving in slots for coarse adjustment, in addition to a large number of fine adjusters. The lathe complete with electrical and all other equipment is 270 tons in weight.

Road Building in Germany

A network of motor roads is to be built in Germany during the next few years. The first plan provides for about 3,000 miles of roads to be completed within five years. The roads will have separate carriageways about 25 ft. in width for each direction of travel, separated by an "island" varying between 12 ft. and 17 ft. in width. The island will be planted with hedges to prevent the headlights of opposing traffic streams from dazzling one another. As far as possible level crossings with other roads will be avoided, as also will curves of small radius. It is hoped to make the roads suitable for travel at cruising speeds of about 65 m.p.h.



Seventy old locomotives, representing a load of 8,000 tons, being used to subject Sydney Harbour Bridge to a dead weight test prior to the opening of the bridge.

Greater Water Supply for Swindon

The Latton pumping station of the Borough of Swindon opened recently by the Minister of Health deals with an additional water supply obtained from a new borehole 231 ft. deep. The water is pumped through 18 in. diameter cast-iron pipes to a new service reservoir on Blunsdon Hill, six miles distant. It flows from this reservoir by gravity to Swindon, $3\frac{1}{2}$ miles away, where it is distributed through branch pipelines. The reservoir at Blunsdon is constructed with concrete walls and floor, and plain concrete columns support a reinforced concrete roof. It has a capacity of 1,333,000 gallons.

The plant of the new station is in duplicate, one set being in reserve. Each set consists of a five-cylinder oil engine developing 275 b.h.p. at 428 r.p.m., and coupled through gearing to a two-stage centrifugal pump rated at 1,834 galls. per min. at 1,500 r.p.m. against a head of 295 ft.

New Grain Warehouse at Leith

The grain handling facilities of the port of Leith, Scotland, have been greatly increased by the recent completion of a fine new warehouse at the Imperial Dock. It is a concrete structure 160 ft. long, 143 ft. wide and 150 ft. high, and has a storage capacity of 20,000 tons of grain. The grain is accommodated in huge vertical bins about 70 ft. high, of which there are 129 in the storage section and 25 in the delivery section. The warehouse is electrically operated, current at 6,600 v. being obtained from the Portobello power station of the Edinburgh Corporation and transformed to 440 v. in a substation near by the warehouse.

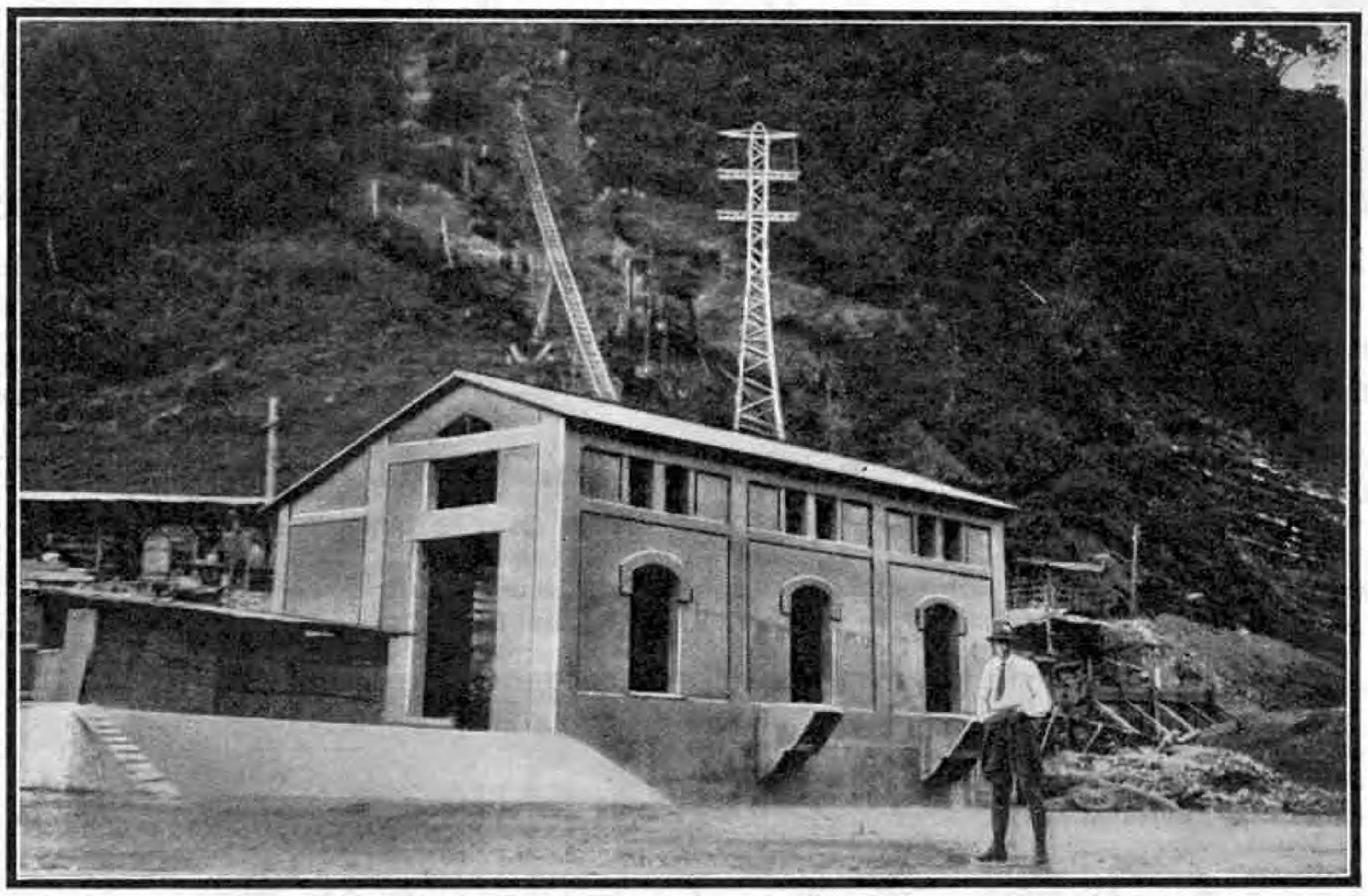
Cargoes of grain brought to the dock are discharged by two pneumatic unloading plants each capable of unloading 180 tons of wheat per hour. The plants deliver the grain to endless belts traversing a gallery above the quay shed, which convey it to a weighing house beside the warehouse. The grain is then passed to other conveyors that take it into the warehouse and deliver it to bucket elevators that raise it to the top of the building and discharge it into the storage bins.

An Automatic Hydro-Electric Plant

Power Station in the Wilds of Mexico

THE situation of hydro-electric power stations in remote and mountainous districts often makes the employment of skilled attendants a matter of considerable difficulty and expense. This fact indeed might render many developments uneconomical if there were no alternative method of operation. In such situations, however, the difficulty can be overcome and the expense saved by the installation of one or other of the various forms of automatic control gear, thus dispensing either partly or entirely with the need for station attendants.

An interesting example of such an installation is the Tezcapa power station of the Mexican Light and Power Company. This station is situated in a mountainous and lonely region of Puebla, 4,570 ft. above sea level and many miles from the nearest town, and its function is to utilise the available energy from a variable water supply to generate electricity for supply to the Necaxa–Noncolco line. Two generating sets are installed, one of 3,800 kW and the other of 1,570 kW capacity, together with automatic control gear by means of which all the operations otherwise requiring skilled attention are carried out. Certain initiating operations, of the simplest nature, are carried out by a peasant attendant who is employed at the station primarily for such duties as keeping the water screens free from obstruction.



The power house and pipeline at Tezcapa, Mexico, under construction. We are indebted for this photograph to the Metropolitan-Vickers Electrical Co. Ltd.

The accompanying photograph shows the power house and pipe-line under construction, and gives some idea of the wildness of the country. The water turbines are of Voith manufacture, and were supplied through Perrins Ltd., of London. The turbines operate at 750 r.p.m. and each turbine is direct coupled to the shaft of its alternator. The alternators, which were supplied by the Metropolitan-Vickers Electrical Company Ltd., are of 4,000 kVA and 1,650 kVA capacity respectively, and generate at 4,400 volts, 3 phase, 50 cycles. Both alternators are arranged to operate at constant excitation for all conditions of water supply. Each generator shaft is strengthened and carries a flywheel, with which hydraulic braking equipment is incorporated.

The output of the sets is stepped up to the transmission voltage of 85,000 v. by means of a 6,000 kVA bank of water-cooled transformers. The generators are connected to the primary side of the transformers through Metrovick metal-clad circuit-breakers, which are controlled by the automatic equipment.

The various devices of the automatic control and protective gear are mounted on large control panels. The operating supply for the relays is derived from a small three-phase control transformer that is connected to the H.T. line so that the sets cannot be started up by means of the automatic gear unless the line is alive. This prevents the station from being connected to a line fault. The oil switch and field switch trip coils and the brake solenoids are operated from a 24-volt nickel-iron battery supplied with a trickle charge from one of the exciters.

When the control transformer is energised, the sets can be started up and connected to the line by the attendant closing small control knife switches. The operation having been thus initiated, all the various steps in the process, including opening the main gates, running up, paralleling, synchronising and closing the main oil switches are performed automatically.

An interesting feature of the equipment is a system of load indication devices by means of which the attendant is instructed what plant to run according to the supply of water available. In normal operation the smaller generating set is started up first. If the amount of water available should increase to a value more than sufficient to run No. 1 machine fully loaded, a signal bell and an illuminated signal board warn the attendant that he should start up No. 2 machine, the larger set, and shut down No. 1. Further increase of water supply operates signals warning the attendant to run both machines. Similarly predetermined values of decreasing water supply give signals for the amount of plant in operation to be reduced.

Protective gear prevents damage to the equipment from faults or other contingencies, and is so arranged that it either shuts down the equipment temporarily or locks it out of commission, according to the nature of the irregularity. When a lock-out occurs the equipment cannot be restarted until the trouble has been rectified.

Modernising Modder River Bridge

An Historic Cape Site

By A. H. Betteridge

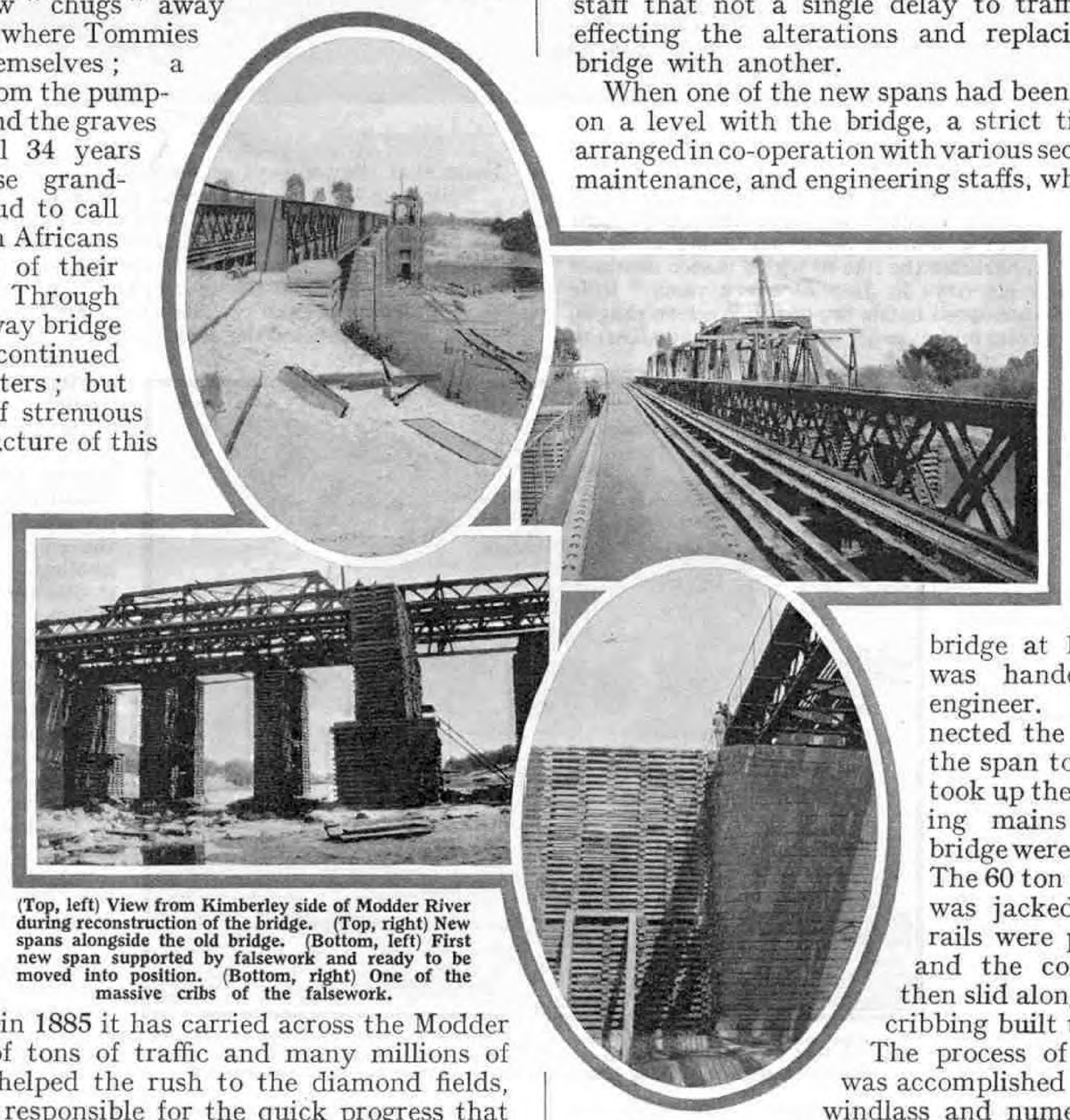
MODDER River is one of many Cape stations at which block-houses erected during the South African war still stand. Its name will ever be associated with the fierce battle of Magersfontein, and the stubborn resistance of the Boers who opposed the British troops on the South bank of the river and effectually delayed their crossing for some days. A clanging pump engine now "chugs" away on the very spot where Tommies entrenched themselves; a hundred yards from the pump-house one may find the graves of men who fell 34 years ago, men whose grandchildren are proud to call themselves South Africans and the friends of their former enemies. Through it all the old railway bridge across the river continued to serve its masters; but after 48 years of strenuous life the superstructure of this 700-ft. bridge has retired to make place for a modern lattice girder type bridge.

In common with many human bulwarks who made the South African Railways the fine service it is to-day, the old bridge has had a long and honourable career. Since it was constructed in 1885 it has carried across the Modder River millions of tons of traffic and many millions of passengers. It helped the rush to the diamond fields, and was largely responsible for the quick progress that followed in Johannesburg after the discovery of gold. Several hundred thousand trains have steamed over the bridge without mishap, but the increased axle loads of our modern steam leviathans rendered the old structure obsolete for main line working.

The new superstructure weighs in the aggregate 20 tons less than the old, although it is considerably stronger, and the cost of replacement was £15,000. More than 20,000 railway sleepers were requisitioned to build the falsework or cribs on which the new spans were built together, and the cost of painting was nearly £500. The last of the eight spans, each weighing 60 tons, of which the bridge is composed, was launched into position last year, but the rejuvenation of the cement and stone piers has only recently been completed.

The process of replacing the old bridge was not as straightforward as might have been thought. The chief difficulty was to avoid train delays during the transformation, and it is a splendid testimony to the engineer and his staff that not a single delay to traffic was caused in effecting the alterations and replacing one 500 ton bridge with another.

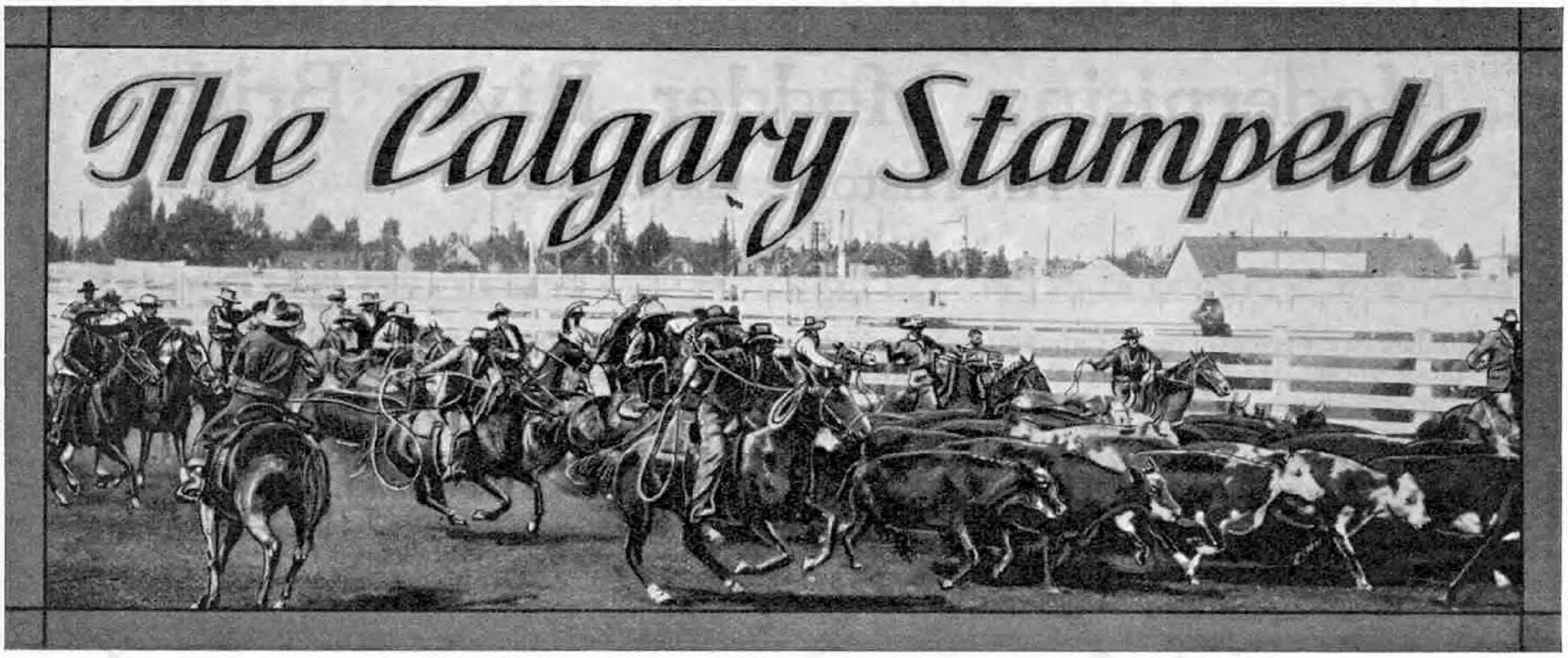
When one of the new spans had been built on the cribs on a level with the bridge, a strict time schedule was arranged in co-operation with various sections of the traffic, maintenance, and engineering staffs, whereby it would be possible to make the change without delay to trains. A Sunday was chosen for this purpose, when a curtailed train service was in operation. When the up and down main line express trains had passed over the bridge at 11.0 a.m. the line was handed over to the engineer. Gangers disconnected the rails each side of the span to be removed, and took up the rails; and pumping mains carried on the bridge were also disconnected. The 60 ton span on the bridge was jacked up and greased rails were placed beneath it, and the complete span was then slid along these rails to the cribbing built to receive it.



(Top, left) View from Kimberley side of Modder River during reconstruction of the bridge. (Top, right) New spans alongside the old bridge. (Bottom, left) First new span supported by falsework and ready to be moved into position. (Bottom, right) One of the massive cribs of the falsework.

The process of sliding the span was accomplished with the help of a windlass and numerous natives. It was found that when all preparations had been made less than 10 minutes were required to propel the span on to its cribbing. From the other side of the bridge the new span was slid into position by a similar operation, and allowed to rest on temporary greased plate bearings. Track was relaid, pump mains reconnected, and great care taken to ensure the correct alignment of the new span with the rest of the bridge.

Only one end of each span is rigidly fixed to a pier. In the old structure the other end was carried on bearer plates, but the modern spans necessitate steel 2 ft. roller bearings at one end of each span.



THE Calgary Stampede, emblematic of frontier days before settlers and homesteaders fenced off the land, and when cattle roamed at will over ranches so huge that days and weeks were required before a man on horseback could circle its outermost limits, is of a character the like of which is seen nowhere else in the world. For six days in July of every year, "Ride 'Em Cowboy," the time-honoured battle cry of the Western ranges, resounds through the streets and avenues of Calgary, that Albertan city of the foothills of the Rockies, far famed as the centre of the Western Canadian cattle ranching country. In the short space of 58 years it has grown from what was a Royal North-West Mounted Police fort in 1876 to the thriving, hustling, bustling, modern metropolis of over 80,000 population of to-day.

From the grass-covered prairies of Alberta, the wild horse districts of British Columbia, the range country of Manitoba and Saskatchewan and the plains of Arizona, New Mexico, Oklahoma, Montana, Colorado and Texas, come cowboys, red men and white, the cream of the broncho "busters," calf ropers, steer decorators and riders of two immense countries, eager to risk life and limb for the pot of gold and the huge silver trophies offered in the world's championship cowboy contest of the world's champion Stampede. Indians of many nations come there too, Blackfeet who in the early days provided anxious times to many a trader, Stonies from the Morley Hills, Sarcees of whom it is said no white man ever learned to speak their language—all flock to Calgary to lead the vanguard of the big Stampede opening day parade, to enter their best riders in competition with their "pale face" brothers on even terms, in riding, roping and other contests.

The gigantic opening Stampede parade itself, five miles long, is alone worth travelling to see. It is headed by mounted Indians of many tribes, decked out in the full regalia of native ceremonial garb—buckskin shirt, decorated with bead work, and topped by a great feathered war bonnet that trails the ground when its wearer is dismounted. Then come Mounted Policemen wearing scarlet tunic and regulation Stetson hat, recalling to mind the many tales of bravery and errands of mercy in the line of duty the Royal Canadian Mounted Police have to their splendid record of service. Truly are they called the guardians of the North, and it is no empty boast that they always accomplish what they set out to do.

Following the policemen come pioneers clothed as in the days of '83—cowboys in coloured silk shirts, schapps, and two gallon hats, booted and spurred. In this section alone there are over 1,200 horses. After the cowboys come the chuck-wagons, clubs and societies, commercial floats, etc., and music is provided by no less than 20 bands. Each year between 50,000 and 60,000 people flock to Calgary to witness the parade, after enjoying which visitors and citizens alike are all in high spirits for the week's celebration.



The upper photograph gives some idea of the thrilling spectacle presented by cowboys handling wild cattle at the famous annual Stampede at Calgary, Canada. The lower photograph shows a bucking broncho throwing its rider in one of the contests.

On two or three mornings there are marvellous displays by the Indians, mounted and beautifully costumed, in the principal business streets of the city. Many thousands of photographs are taken, and the streets are thronged with people anxious to get close to the gorgeously clad "First citizens" of Canada.

The Stampede programme is easily the feature event. Held every afternoon and evening within the grandstand enclosure, and before a grandstand that is the second largest in Canada, the championship cowboy contests attract the "top hands" of Canada and the United States. It is no empty title that the "bronk snappers" ride for. The Calgary Exhibition and Stampede offer generous cash prizes, and numerous special prizes are given by prominent business men and motion picture stars.

There isn't a chance in the world of any "drug store" cowboy winning a championship title at the Calgary Stampede, for in the hills and over the prairies of Alberta are running hundreds of the toughest outlaw bronks that ever threw a cowboy, and it is the bronk snapper that can sit the worst of these outlaws who will win the money. Every district in Alberta sends its top horses to the Stampede, and in addition to these the Calgary Exhibition Board own outright 40 head of the worst horses in the province for use in the finals.

Not content with gathering together a trainload of equine dynamite, the management bring from Texas a herd of the famous Brahma steers for use in the steer riding and steer decorating contests. And maybe these salty cattle from the Southern States can't buck! Of the 100 head of Brahmas sent out of the bucking chutes at the Stampede last year less than 10 were successfully ridden! The cattle, which have been wintered in the foothills west of Calgary, are in prime shape for the contests.

Every contest known to the cowboy world is on the programme. Consider the list—the bucking horse riding championship with saddle, for the North American championships; Canadian championship bucking horse riding contest; bareback bucking horse riding championship; wild cow and wild steer riding; calf roping; wild steer decorating; chuck wagon races; Indian races; wild cow milking and wild horse races!

The wild steer decorating is a thrilling contest, having all the thrills of the old bull-dogging contest without the necessity of having to twist the animal down. Here is what happens. The steers are penned in a chute. The decorator, mounted, takes up a position on one side of the chute, and his hazar, also mounted, guards the other side. When the steer is cut loose the decorator rides madly after him, drops down on his horns—if he is lucky enough to get there in time—and then slips a red ribbon over the steer's horn, turns him loose and signals for time. One of the decorators at Calgary nailed his steer in five seconds, a new world's record that will take some beating.

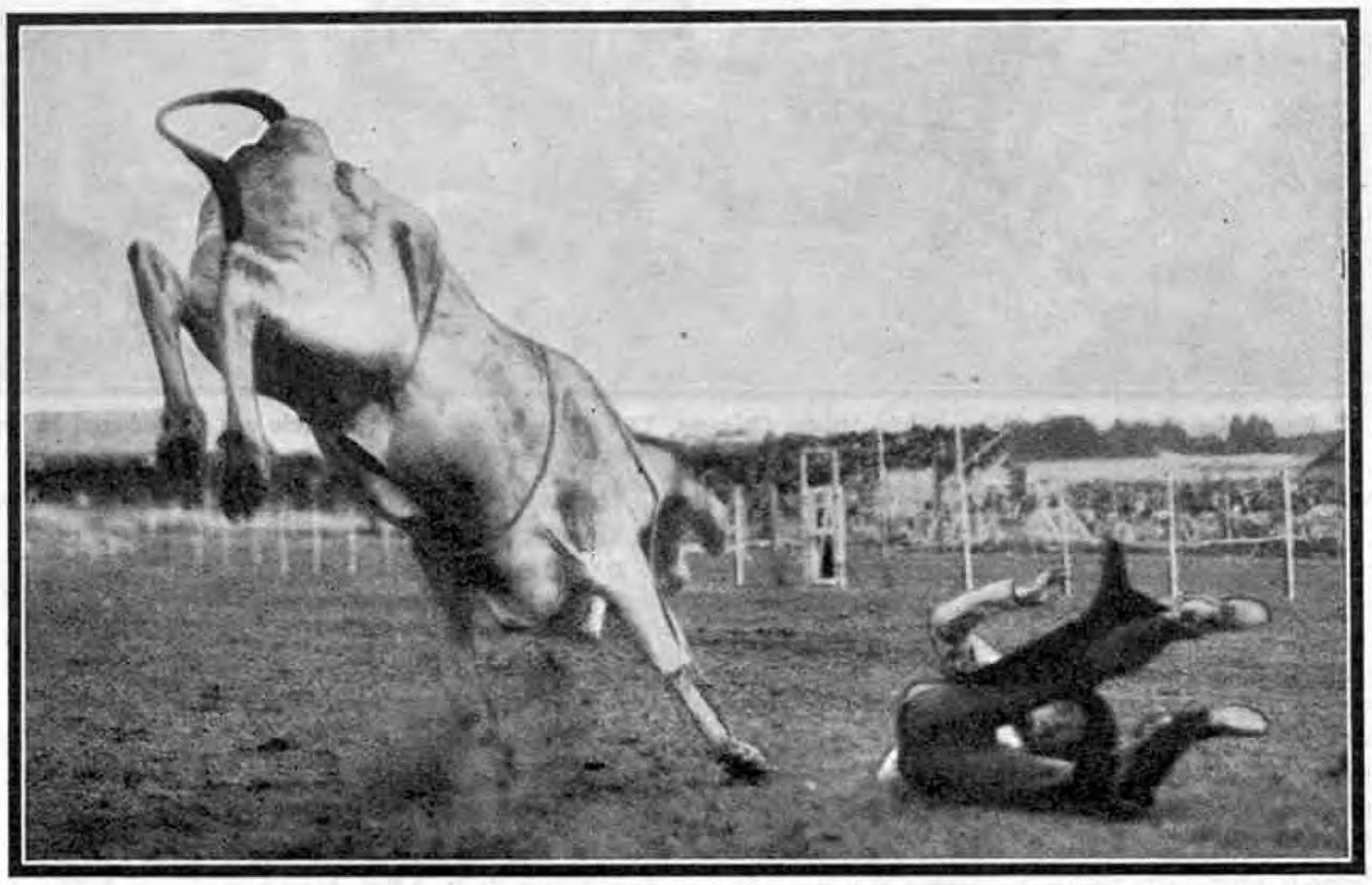


Mounted Indians of many tribes, in native ceremonial dress—buckskin shirt, decorated with bead work, and topped by a great feathered war bonnet— at the head of the great Parade that marks the opening of the Stampede.

The "chuck wagon" race has become one of the greatest drawing cards of the week. It is part of the evening programme, and includes from 15 to 20 chuck wagons from ranches in different parts of Alberta. The outfit consists of the chuck wagon, the driver, and four outriders, the wagon being drawn by four horses, which makes eight horses to the outfit. There are therefore from 150 to 160 horses in the race. They race in relays of four or five outfits at a time. The start is made from camp in the centre-field, and at the word "Go," they break camp, the riders mount their horses, and the driver makes a figure-eight around two barrels and out on to the track, and runs a half-mile, finishing under the wire in front of the grandstand. This race is certainly the last word in thrills. It is continued for four nights, and on the fifth night the best five wagons compete for the final money.

The bronks, steers and calves used in the Stampede are taken care of in large stout corrals that open out into chutes and stalls from which the animals are released. Every chute is numbered, and it is comparatively easy to follow the directions given by the announcer before each ride is made. Every cowboy taking part in the Stampede must be attired in regulation costume. This includes the big Stetson hat, gaudy coloured silk shirt, schapps, the leather "pants" worn by cowboys to protect them from injury and discomfort in a score of ways, the fancy high-heeled riding boots, spurs, and other equipment.

The chuck wagons used in the chuck wagon race are the travelling commissaries of the range. Here all the cooking is done, and the bedding of the men on the round-up is carried.



A typical scene during the Brahma Steer Riding Contest. The attitude of the wild steer gives a good idea of the force and suddenness with which the rider was unseated.

The "round-up" is what the name implies. Twice a year the cattle and horses on the range are rounded up or gathered in for either branding or tallying purposes. All the cowboys in the district are marshalled together for this important job, and stray "mavericks," or unbranded calves, are "cut out" from the herd, branded, and claimed. A "remuda" is the herd of horses used by the cowboys for round-up purposes. Every man has half-a-dozen head of special saddle horses, and these are in charge of a "wrangler," the cowboy who is boss of the herd.

"Chute men," whose duty it is to see that the bucking horses are properly saddled and flanked, are an important part of the Stampede. Old time champion riders, and men who know all the tricks of the trade are usually used in this work.

Cowboy contests, formerly known as "Rodeos" have been held for years in every district where cowboys and cattlemen foregather, but it was not until 1912 that the "Stampede" was born. In that year a little group of cattlemen known as "The Big Four," namely Patrick Burns, Esq., A. J. McLean, Esq., the late George Lane, Esq., and the late A. E. Cross, Esq., listened to the representations of a young cowboy named Guy Weadick, the present manager of the Calgary Stampede, and the result of the conference was that the original Stampede was held.

The contests attracted cowboys from all parts of the United States and the Stampede was an outstanding success. A young Blood Indian from MacLeod, Tom Three Persons, won the riding championship, in the presence of the Duke of Connaught, Princess Patricia and other distinguished visitors.

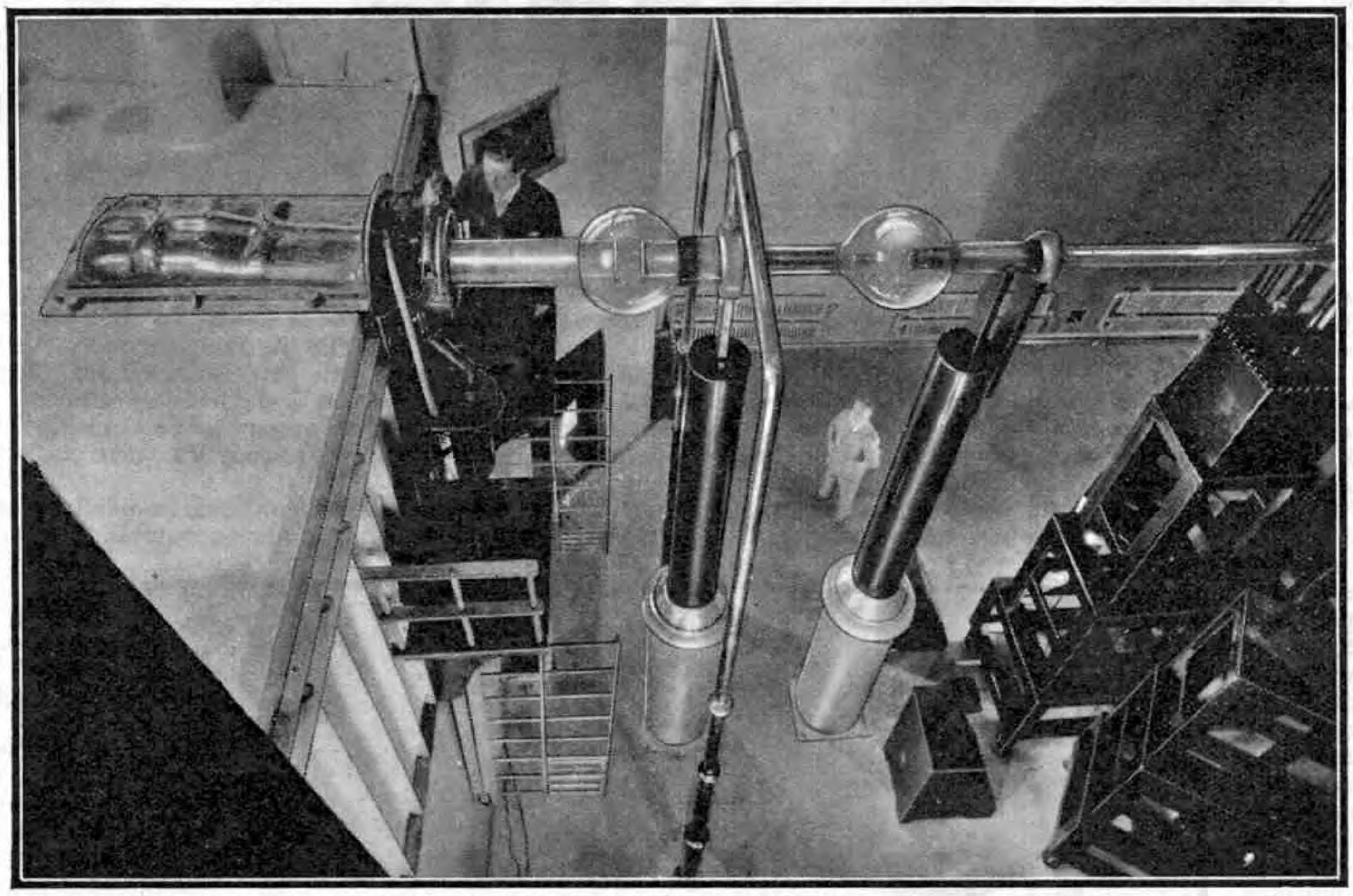
In 1919 another championship Stampede was held and then in 1923 the directors of the Calgary Exhibition Board decided to incorporate it as a feature event of the annual exhibition. It was a happy thought, for since that year the Stampede has been held continuously as part of the exhibition and has reached the spot where it is now the most successful affair of its kind on the continent.

The annual western celebration in Calgary is featured by numerous unique events. For days before the big event is scheduled to take place, the modern western city reverts to the old cow-town days. Merchants build false fronts on their shops, depicting the log cabin stores of the early days. Citizens, young and old, don the cowboy hat, and coloured shirts and scarves, so common to the husky sons of the ranges. Chuck wagons from the range districts of the province replace automobiles and street cars in the down-town districts; automobile parking places give way to hitching racks for saddle horses, and cowboys help out the eating houses by serving "flap jacks" and coffee to all and sundry.

X-Rays and Life

Curing Disease and Creating New Plants

THE article appearing on page 538 of last month's *"M.M."* showed how valuable X-rays are in detecting flaws and defects in iron, steel, wood and many other materials used in industry. Important as is this use of the rays, it represents only one of the many remarkable applications of which they are capable. In addition to giving us the power of seeing deep into things that are opaque to ordinary light, the rays provide us with means of effecting changes of many kinds. For instance, they not only enable us to study the sizes and shapes of the internal organs of the body, but also to treat abnormal conditions, and to-day they are applied in small and carefully regulated doses to the treatment of ulcers and cancers, which they destroy. The rays are capable of producing disease as well as curing it. Unrestricted exposure to them may give rise to what is known as X-ray dermatitis, a dreaded skin disease, but when suitable precautions are taken they can be used without danger, and have proved of extraordinary value.



800,000 volt X-Ray Tube at the Mercy Hospital Institute, Chicago. The illustrations to this article are reproduced by courtesy of the General Electric Company of New York.

The treatment of cancer by means of X-rays is one of the most promising of their uses. Small X-ray tubes are employed when the cancer to be attacked is easily reached, and deep-seated cancer can be treated by means of convergent beams of penetrating X-rays, from tubes of greater power. These are focussed on the place affected by the disease, and the measured doses employed produce no ill-effects on the skins of patients so treated, for the rays are spread out over a comparatively large surface and their direction towards the cancer or ulcer is changed frequently to avoid over-exposure of other parts.

The most recent development of this method of fighting cancer is the installation in the Mercy Hospital Institute in Chicago of a giant X-ray tube operated continuously at 800,000 volts. This voltage is considerably higher than that of any other installation in regular operation, and the current capacity of the tube is twice as great as that of any X-ray tube previously constructed. The penetrative power of X-rays, and their capacity to deal with deep-seated disorders, increase with the voltage, and the new tube therefore adds greatly to the power of the weapons available in the war against disease.

The curative effect of X-rays in the case of cancer is due to the destruction of the cells affected by the disease. Many years ago it was discovered that unregulated doses of the rays appear to be destructive of certain forms of living matter. When careful measurements were made of the wavelength and penetrative power of the rays, and of the periods during which they were applied, however, the surprising fact was revealed that in certain cases they have a stimulating effect. For instance, the hatching of silkworm eggs actually was speeded up by exposing them to regulated doses of X-rays, but on the other hand an experimenter who tried this method of hastening the growth of caterpillars similar to the silkworm only succeeded in killing his subjects. Later the effect of X-rays on sunflower and tomato seeds was tried with surprising results. Wet seeds ready to sprout were exposed to the rays, and in each case an extraordinary crop of seedlings was obtained. Many of these seedlings were smaller than the normal plants; others were larger and some showed strange variations such as ribbon-shaped stems, an increased tendency to branching, and ability to flower at an early stage of growth.

Astonishing new varieties of plants have now been produced in this manner. For instance, in one series of experiments more than 1,000 tobacco plants were grown from seed that had been exposed to X-rays, and 250 of these actually were new variants, being larger or smaller than the standard plant, having leaves of varying sizes and colours, and flowers varying from light pink to purple-red. Strange new types of barley, maize, potatoes and even cotton also have resulted from X-ray bombardments of seeds. Cotton is a particularly interesting case, for the cotton lint in the ripe head of one of the new varieties was entirely separate from the seed. The extraction of the seeds is one of the most tedious and expensive operations in the process by which cotton is prepared for the spinner, and much trouble would be saved if this new variety could be developed for cultivation. Another cotton plant variant produced by means of X-rays had giant seeds, and this also would prove of great value commercially owing to the increased yield of cotton-seed oil that could be obtained from a single plant.

A wide field of work is opened up by these discoveries, and it is interesting to find that an electrically-heated greenhouse now forms part of the research equipment of the General Electric Company of New York. This greenhouse is built on the roof of the Research Laboratory at Schenectady, and houses plants and seedlings that are being carefully observed in order to trace the effect of X-raying the seeds from which they have been produced.

The scientists conducting these experiments have already been given many surprises, and the lower illustration on the following page shows one of them. It represents grapefruit plants that produced flowers when they were five weeks old! Normally grapefruit plants do not flower until they have been grown for at least five years, and usually they are 10 years old before they become productive. They are then several feet in height, but the astonishing plants shown in our illustration were less than 2 in. high, and actually their seed leaves were still visible on their stems. One of the plants lacked green

colouring matter, and both flowers of course were dwarfs, but otherwise were normal in appearance.

There were two of these plants, and the seeds from which they were grown were from commercial stock, but were exposed to X-rays after soaking in distilled water. They were planted in seed boxes in the greenhouse eight days later, and sprouted in about a month, the flowers making their appearance nearly six weeks later.



Electrically heated greenhouse in the Research Laboratory of the General Electric Company of New York, where experiments are being made on the effect of X-Rays on plant life.

It would have been interesting to leave the flowers in order to see if they developed to the fruiting stage; but unfortunately this could not be done, for their pollen was required for other experiments. It is scarcely likely that they would have formed fruit, and even if they had done so the product almost certainly would have been very small; but the growth of these extraordinary specimens encourages the hope that further trials will yield varieties of grapefruit plant that will bear fruit earlier than those now in cultivation. Other grapefruit seeds treated in a similar manner gave rise to plants with such peculiarities as dwarfed stems, double leaves, and blotches of white.

Astonishing variations in animal life also have resulted from X-ray treatment. The fruit or vinegar fly was the centre of the first experiments in this direction. This fly is a small, greyish-brown insect, with bright red eyes, that is often found on bunches of ripe bananas. At first flies exposed for various periods to X-rays from a 50,000 volt tube died five days later, but a safe dose was then discovered, and interesting changes were noticed in the descendants of the tiny creatures that had received treatment. The flies themselves did not necessarily show any change, and yet generations later their race showed the effects of the experience they had undergone. Some of their offspring were giants; others were feeble individuals that never grew to maturity. Literally thousands of new variations were brought into existence, but as yet no way of controlling the action of the rays to produce any definite type, such as one of the giant races, has been found.

The most striking feature of these experiments is the discovery that variations do actually result from exposure to X-rays, probably as the result of subtle changes following the liberation of electrons in the tissues bombarded by them. The importance of this lies in the fact that the entire plant and animal creation is normally exposed to the action of radioactive materials in the earth, and also to cosmic rays, which are similar to X-rays, but are even more penetrating. Although these are not as concentrated as are the beams of X-rays used in laboratory experiments, they bring about similar results, and in part at least may be responsible for the origin and development of species. This has been tested by experiments on fruit flies kept in an abandoned mine in Colorado that yields carnotite, a uranium ore containing radium. There more new varieties were produced than in the open air, and in the radioactive atmosphere of the mine the process of natural evolution seems to have been speeded up, exactly as it is hastened in the laboratory by the action of X-rays.

Other plants and animals have been exposed to the rays with equally surprising results, and one experimenter has even suggested the possibility of producing a worm that cannot grow, but on the other hand cannot die. What the end of these experiments will be it is at present difficult to say. Many of the variations obtained, perhaps most of them, will be mere freaks, but the possibility of producing improved varieties of plants, and even of animals, suggests that man can increase his resources by means of X-ray bombardments. For instance, it may be possible to produce an orange tree that resists cold, and a giant sequoia, the world's largest tree, that can be grown in colder climates than that of California, its only known home to-day, to provide immense stores of valuable timber. Similarly new flowers and perhaps new vegetables are possible. The production of double gladioli and double paper-white narcissi are triumphs that already have been achieved by means of X-rays, and others will follow when we know more about the changes the rays are able to bring about and have learned to control their action. At present much of the work of exposing plants or animals to the action of X-rays may be wasted owing to lack of sufficient knowledge of the manner in which the radiation acts.



Grapefruit plants, produced from seeds treated with X-Rays, that flowered when only five weeks old.

Similar experiments also are being carried on with cathode rays, the streams of electrons streaming from the negative electrodes of vacuum tubes. Although these are not so penetrative as X-rays, they have much the same effect on living matter, probably because they produce X-rays on striking the animal or plant tissues on which they are directed.



The illustration on this page shows a famous old well at Harbledown, a village of great antiquarian interest near Canterbury. The well is situated in a meadow on a farm, and at its head is the royal crest of Edward, Prince of Wales, better known as the Black Prince, the hero of Crecy and the victor of Poitiers. Tradition says that the Prince, on his way from the coast when returning to this country after the Battle of Poitiers, bringing with him the French King as a prisoner, bathed in the waters of this well because of its supposed miraculous or medicinal virtue. Later, when he was dying of consumption, water was brought from the same source for him to drink, in the hope that it would effect a cure. The well, with the steps leading down to it, is in an excellent state of preservation, as the photograph shows.



The Black Prince's Well at Harbledown, near Canterbury. Photograph by A. W. Tiffin, Staplehurst, Kent.

Catfish give Earthquake Warnings

The catfish is not attractive in appearance, for its colour is that of lead and the soft warts on its face and the spines projecting from its jaws are chiefly of interest to a naturalist. It has recently become of importance in Japan, however, and is now regarded as an oracle to be consulted by those who wish to learn if an earthquake is likely to occur. The fish is kept in a tank and is questioned every six hours by tapping the table on which its home stands. If it ignores the questioning tap, all is well ; but an earthquake may be expected within six hours if it answers by plunging furiously through the water.

It is not surprising that this astonishing discovery should come from Japan, for there great interest naturally is taken in earthquakes because of their frequency and the extent of the damage and loss of life they cause. Unfortunately the catfish cannot tell whether the earthquake it forecasts will be a mere tremor or a violent convulsion. It is not likely to be of real value in Japan, therefore, since in that country earthquake shocks, most of them slight, occur so often that the oracle would practically always give the same answer. In countries where shocks are rarer, the fish might be useful.

Nature Forestalls the Industrial Chemist

Most readers of the "*M.M.*" are familiar with the carbon dioxide snow now used so largely for keeping foodstuffs cool during hot weather, and know that it is produced by allowing compressed carbon dioxide to expand, the resulting fall in temperature causing the gas to solidify. Special plants have been erected in many countries for its manufacture, and it is interesting to find that in this instance man has been forestalled by Nature, for a well in Colorado, in the United States, yields snow white carbon dioxide frozen to a temperature of 20 deg. F. below zero by an exactly similar process. It seems that there carbon dioxide from an unknown source is stored below ground under very high pressure, and when it comes to the surface it loses heat so rapidly owing to its expansion that the temperature is lowered below its freezing point. In the earth the gas is mixed with a small percentage of oil, and this also is frozen as it reaches the surface.

Sea Water at 1/2 a Pint !

It would be difficult to imagine anything on Earth more abundant than sea water, and yet this is said to cost 1/2 a pint in Czecho-Slovakia ! That country of course has no sea coast, and it was necessary to import sea water when this liquid came into fashion as a tonic because of the ideal proportions of iodides and chlorides it contains. It is brought from the North Sea in the neighbourhood of the island of Heligoland, and also from the Black Sea ; and in both cases water from a depth of 30 ft. is pasteurised and bottled ready for sale. The Czech physician who has popularised it recommends that it should be added to unsalted soup.

More Stranded Whales

A contributor to the "From Our Readers" section of the "*M.M.*" for May described the extraordinary spectacle presented by a school of whales stranded on the beach of Zanzibar Island. These were "false killers," and the writer of the article commented on the fact that most of them were scarred or marked on the back, and suggested that they had been chased ashore by some powerful enemy. This is not necessarily the case, however, for whales that feed on cuttlefish or octopus, as the "false killers" do, often become marked by the powerful beaks of these creatures, and similar marks have been noticed on the backs of other species of whales stranded in a similar manner.

The stranding of whales is by no means uncommon. Many instances have occurred within recent years, and I am able to reproduce this month an interesting photograph of a school of whales left ashore in the mouth of the River Avon, at Windsor, Nova Scotia, when the tide receded. These whales were described as "cawing" whales, and it is probable that they were pilot whales, for these creatures are given a similar name by the people of Cornwall, who refer to them as "ca'ing" whales, to give the usual spelling of the name. "Ca'ing" means leading, and the name is an expressive recognition of the habit of these creatures of following one or two large bulls that act as pilots for the school.

There was a famous stranding of "ca'ing" whales in Mount's Bay, Cornwall, in July 1911. The creatures that came ashore were first seen as dark objects moving about in fairly deep water, and finally they came into the shallows and were unable to escape when the tide receded. No fewer than 64 whales were then seen laid on their sides, helpless and stupid, occasionally flapping their flukes, but making no real effort to escape. Many of them died before the tide returned, and to the astonishment of the onlookers the survivors then carried out to sea actually came up the beach again and again, possibly still clinging to the idea of following their pilots, which were the largest of the whales and among the first to perish. It will be remembered that the whales stranded on the shore of Zanzibar Island behaved similarly,

returning to shore even after being dragged into deeper water in order to give them a chance to escape.

In prehistoric times, and indeed until quite recently, a stranded whale was acclaimed as a prize, whatever the species. This was only natural, for it yielded valuable oils and in many cases whalebone. The flesh also is by no means to be despised, and certainly was greatly relished by our forefathers. Even to-day the advent of a stranded whale is hailed with glee by Eskimos and other primitive races among whom the struggle for a mere existence is more intense than in the civilised world.

A Wonderful Indian Building

The Taj Mahal, which is illustrated in the lower left-hand corner of this page, is universally recognised as one of the most beautiful buildings in the world. It was built at Agra, in India, by Shahjahan, the Mogul Emperor of India, as the mausoleum of his favourite wife Mumtaz Mahal, and he himself lies buried there. It is of impressive size and there is a tradition that 20,000 men laboured on it for 20 years.

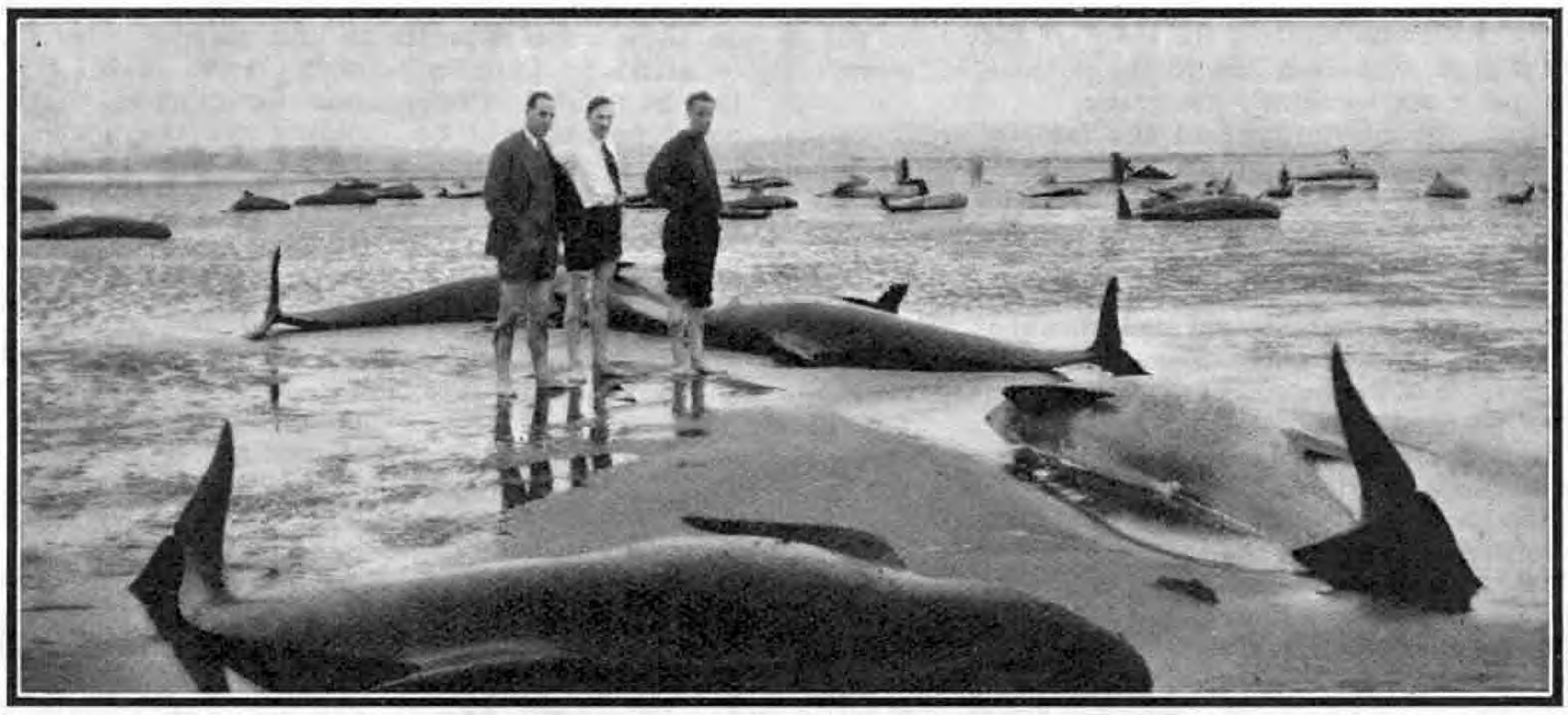
Many stories are told of the origin of this famous tomb. It is said that the design of the building was revealed to the Empress in a dream, but no architect capable of drawing the plans from her description could be found. Eventually a mysterious old man administered a drug to one of these officials, to whom the monument then was revealed in all its glory; and under the spell of the magic drug the inspired architect worked rapidly and feverishly, to fall back exhausted as soon as the plans were complete.

The tom is built of white marble, and stands on a platform of red sandstone. The interior is beautifully carved, the designs being painted and showing flowers only; and in the central hall are wonderfully ornamented marble lattice screens surrounding the tombs, that of the Empress being directly under the centre of the dome and the larger one of Shahjahan on one side of it. The walls and screens are inlaid with jade, lapis lazuli, cornelian, onyx, jasper, and other precious stones, and inscriptions from the Koran are elaborately carved in Arabic characters.



Moth that Lives for One Day

The lower right-hand illustration shows the cocoons of the silkworm. The task of spinning occupies the silkworm four days, and its unceasing labours during that time may produce as much as 1,300 yds. of unbroken double thread that forms a complete covering for it. Within its silken chamber the chrysalis develops slowly into a moth, and when the cocoon is from two to three weeks old the insect softens one end by means of a liquid emitted from its mouth, and pushes its way out through the tangle of fibres. If it is a male it dies a day or so later; the female only survives two or three days, but finds time to lay from 300 to 400 eggs.



A school of "Cawing" whales stranded in the mouth of the River Avon at Windsor, Nova Scotia. Photograph by courtesy of the Editor of "The Caduceus."

Death Rays Again

Interest in the fascinating topic of death rays was renewed a few months ago by the revelation of surprising experiments made by Mr. Chadfield, a lecturer on electricity at Leicester. Mr. Chadfield succeeded in devising apparatus to produce high-frequency oscillations of 300,000,000 cycles per second between copper plates about 2 ft. apart, and flies, mice and other small creatures placed in the path of the oscillations died immediately. No external injuries could be perceived on the bodies of these creatures.

It has been suggested, in explanation of the effects of high-frequency oscillations, that the nervous impulses of living animals are electrical in origin, and that they can be destroyed by electrical vibrations of similar frequency, just as a wineglass is shattered when its fundamental note is strongly sounded near it. Mr. Chadfield is said to be continuing his experiments with more powerful apparatus, and it will be interesting to see what will be the outcome of further trials.

I have been reminded of this new death ray by the report that the famous scientist Dr. Nikola Tesla claims to have perfected means of transmitting electrical energy by wireless. Dr. Tesla has long had the reputation of being an electrical wizard, and for many years he has been trying to solve the problem of broadcasting energy on a large scale and without loss. As long ago as 1898 his apparatus radiated sufficient energy to burn out the armatures of dynamos in a factory at a distance of five miles, where nothing was then known of his experiments, and the repeated electrical breakdowns they caused greatly mystified the engineers.

It is difficult to imagine what effect success in an enterprise of this kind will have. If power could readily be transmitted and received by wireless, it would no longer be necessary to equip ships and aeroplanes with heavy and powerful engines, and much valuable space could then be devoted to cargo and passenger accommodation. Explorers in uninhabited lands and in Polar regions would be able to tune in power to light their lamps, or to cook food, from the great radiating stations in civilised centres; and the members of mountain climbing expeditions, such as those that attempted the conquest of Mt. Everest, would be relieved of much of the drudgery of carrying stores up to camps at various stages of their ascent. Mining machinery in remote regions could then be driven by power collected by an aerial receiver from gigantic central power stations erected in the most favourable positions.

The Smallest Bird in the World

The smallest bird in the world is little more than half an inch in length, and its thin curved beak actually is longer than its body. It is a pigmy hermit humming bird from Brazil, and is brownish-yellow in colour and much less vivid in appearance than larger creatures of this species. Its size is reflected in the noise it makes when hovering, for this resembles the buzzing of a humble bee, while ordinary humming birds make a sound like that of an electric fan in action.

Visitors to Whipsnade this summer should make a point of seeing this remarkable bird, for a specimen now displayed there is the first of its kind to be exhibited in any zoological garden in the world. It has been given a special home in a small glass cage over which is a lamp arranged to illuminate its plumage as it darts backward and forward.



Making St. Paul's Cathedral Safe

Meccano Model Aids Restoration Work

THE task of maintaining a large and famous building, such as a great cathedral, is a heavy responsibility, for many causes may lead to deterioration if their effects are not detected and checked. The ravages of the atmosphere may lead to decay of the stonework; wooden beams and pillars may be attacked by the death-watch beetle or otherwise unfitted for the part they have to play; and in certain cases vibration due to the passage of heavy traffic may make repairs and renewals necessary.

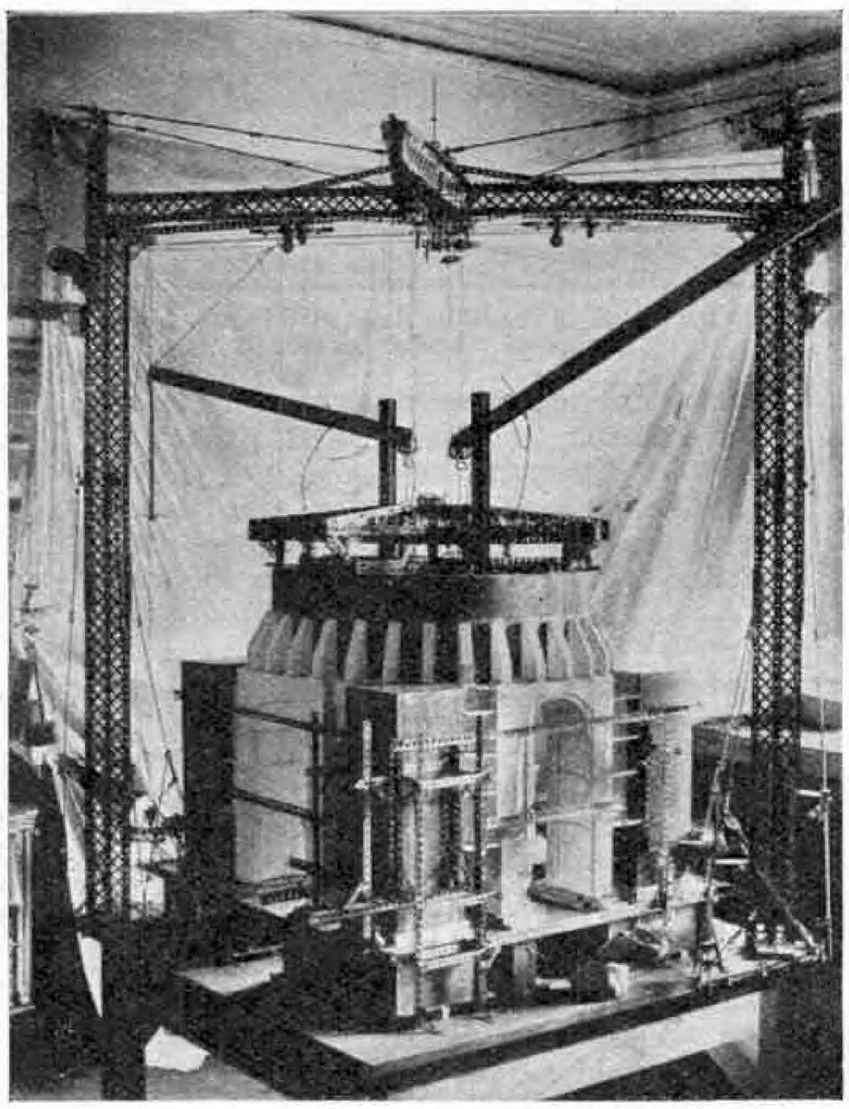
St. Paul's Cathedral, the masterpiece of the famous architect Sir Christopher Wren, is no exception to this rule. About 10 years ago its condition gave rise to serious anxiety, for signs of weakening and distortion were discovered in the piers that support the great dome, and it was feared that there would be a disastrous collapse if immediate steps were not taken to strengthen them.

The dome is an immense and complicated structure that actually consists of three parts. One of these is a cone of brickwork, that carries the lantern and the famous cross on the apex of the building; and above and below it are two ornamental domes that are visible from the outside and inside of the cathedral respectively. It is planned on an enormous scale, for its outside diameter is 145 ft., and the top of the cross on its summit is 370 ft. above the level of the pavement on which the entire building rests. Its weight and that of the drums on which it rests impose a heavy load on the piers supporting them, and when these piers began to show signs of inability to fulfil their task it became necessary to remove parts of the masonry in order to investigate their structure and to enable plans for strengthening them to be formed. The piers have been repaired, filled with concrete forced in under pressure, and strengthened by means of reinforced rods, so that they are now solid structures. In addition, new chains of stainless steel have been employed to encircle the drums at the base of the brick cone in order to give additional strength. This is an extension of a device adopted by Sir Christopher Wren himself.

One of the most interesting features of the restoration work has been the extensive employment of scale models, for the purpose of showing the details of the piers and the dome in order to enable the engineers and architects concerned to decide upon the remedies to be adopted. The labour of repeatedly climbing stairs and ladders was avoided by the use of these models, and the time required for examinations, and for considering the remedies to be applied, was considerably reduced. In following this plan, those responsible for the restoration were employing Wren's own methods, for the great architect made good use of both small and full-sized models.

All the models employed in the recent investigation were made by the staff of Mr. E. J. Bolwell, Clerk of Works of St. Paul's Cathedral. They were very carefully constructed in order to reproduce accurately the details of the originals, and were made in sections so that the exact formation of the parts of the Cathedral they represent can be seen at a glance. One of the finest of them is a reproduction in mahogany to a scale of $\frac{1}{2}$ in. to 1 ft. of one of the piers supporting the dome. This model is about 6 ft. in height, and was built to measurements taken during actual work on scaffolds erected for the purpose. Interior details were verified from inspection holes in the original, and photographs and drawings were liberally employed in order to ensure accuracy.

A model of special interest to readers of the *"M.M."* was used to examine the distribution of the heavy load of the dome on the piers. Wren's aim was to spread this load over as large an area as possible, and the design he adopted for this purpose gave rise to stresses on areas of masonry that were not intended for loads of the magnitude they were called upon to bear. It was necessary to obtain an approximate measurement of the loads on these areas in order to find a remedy for the trouble, and it occurred to Captain Stanley Peach, F.R.I.B.A., a member of the St. Paul's Preservation Committee, that this information could be obtained by building a scale model of the dome area—that is the piers and the drums resting on them that support the dome—and applying a load representing the weight they are called upon to bear. He built the model of materials reproducing as closely as possible the actual conditions in the Cathedral itself, and then had to construct a mechanism to apply the required load by mechanical means in such a manner that it could readily be measured. This required careful consideration, and finally Captain Peach decided to make use of Meccano parts because these possess the necessary strength and rigidity, and their great variety provides means of dealing with all problems in construction and handling.



Model of the dome and piers of St. Paul's Cathedral devised to investigate stresses imposed by the weight of the dome. Illustration reproduced from "The Model Engineer" by courtesy of the Editor.

The model devised by Captain Peach is seen in the accompanying illustration, which is reproduced by courtesy of Mr. E. J. Bolwell. It shows the piers and the drums above them, on which the measured load to represent the weight of the dome was to be placed. A Meccano framework was built over the model of the dome area, and its position fixed with the greatest precision in order that the load should be applied correctly. It will be seen that the loading material was suspended from the framework by means of pulleys; and when it rested on the drums, the weight was transmitted through them to the piers, where it applied stresses that gave some indication of the probable effects of the weight of the dome on the piers of the Cathedral itself.

In order to trace the distortions and fractures that were caused in this manner, slabs of plaster were inserted at various points in the structure, and the manner in which they fractured was carefully investigated, while the distortions of the miniature piers also were carefully examined. The general effect produced in the parts of the model was similar to that detected in the Cathedral piers themselves, and the information gained was of the greatest value in deciding upon the measures to be adopted to repair damage to the structure and to prevent its recurrence. Thus Meccano has played a great part in ensuring the safety of Wren's great Cathedral.

All the models constructed under the direction of Mr. Bolwell were made in sections, for each was intended to illustrate the actual structure of the part reproduced in miniature, as well as its outward form. In one case this principle was extended in order to enable the effect of alterations to be studied as completely as possible. This was a reproduction of half the dome area that was constructed in whitewood. The model was built up of small blocks pegged together and from time to time it was altered for the purpose of testing various schemes of reinforcing the piers and of adding chains to strengthen the dome. In its final form, therefore, the model showed exactly how the restoration work was carried out. The positions of the two new stainless steel chains surrounding the dome can be seen in it, and one of the miniature piers is provided with a glass front in order to show how the reinforcing rods have been put into the cement used to strengthen the pier.

A Test Run on "Cock o' the North"

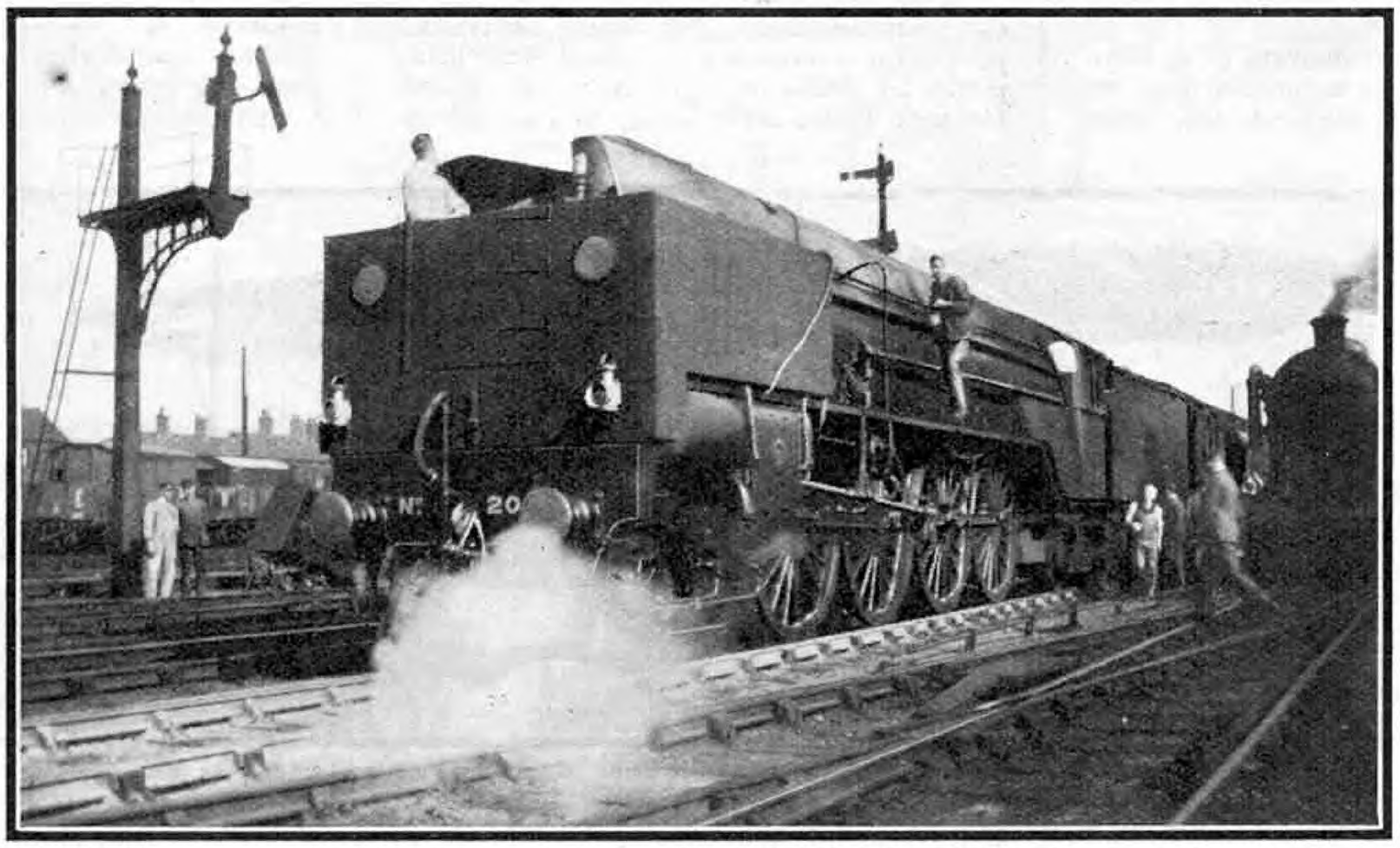
Hill Climbing Feats of New Locomotive

By a Railway Engineer

IN last month's "*M.M.*" readers were promised an account of a footplate trip on "*Cock o' the North,*" the magnificent 2–8–2 express engine recently introduced on the L.N.E.R. Up to the time of writing it has not been possible to make such a run over the difficult route between Edinburgh and Aberdeen for which "*Cock o' the North*" has been specially designed, but we are able to give a description of a test journey from King's Cross to Doncaster carried out during an extensive series of trial runs in both directions on this section of the L.N.E.R. main line.

A preliminary test was made on Tuesday, 19th June, when the engine hauled a specially made up train with the enormous weight of 650 tons from London to Grantham and back with great success. During the first week in July, a series of "full dress" trials were carried out. Each day the engine worked the 11.4 a.m. up Yorkshire Luncheon Car express from Doncaster to London and returned on the very heavy 4 p.m. train, which carries in addition a portion for Grimsby and Cleethorpes.

On these journeys every single feature of the engine's working was under the closest observation. Steam indicators were fitted to the cylinders for measuring the horse power developed. A shelter was erected round the smoke-box to protect the men riding right out on the front of the engine for the purpose of taking the indicator diagrams — mighty hot work with the thermometer at 80 in the shade!



L.N.E.R. Locomotive No. 2001, "Cock o' the North," at Peterborough during a trial run. The engine is fitted with an indicator shelter and a dynamometer car is coupled to the tender.

Immediately behind the tender, in front of the ordinary passenger coaches, was coupled the dynamometer car. This marvellous vehicle is a completely equipped engineering laboratory on wheels. Under the floor is a strong spring, one end of which, called the "live" end, is attached to the tender coupling. Acting just like a great spring balance, it measures the pull exerted by the engine. To start a 650-ton train from rest, "*Cock o' the North*" exerted a pull of about 16 tons, while the pull when travelling at 60 m.p.h. was as high as six tons at one point. A system of delicate levers operated by this spring work a pen that makes a continuous record of the pull on a seemingly endless roll of paper. The rolls on which this paper is wound are driven directly off the wheels and thus the paper is passed underneath the pen at a speed proportional to that of the train. A similar roll chart is used for continuously recording the speed, the pen in this case being driven by an electric clock.

Many other quantities are measured, among them the amount of coal, oil and water used and the temperature of the steam at various points. Even the exhaust gases in the smoke-box are analysed.

During the interesting test week I travelled with "*Cock o' the North*" on a run with the 4 p.m. express from King's Cross, and witnessed a magnificent performance. The load consisted of 16 bogie coaches and the dynamometer car, weighing 548 tons empty and 585 tons with passengers and luggage. No attempt was made to break records; the object of the test was to work the train to schedule time in the most economical manner.

We made a fine start. From King's Cross the line rises steeply at 1 in 105 out to Holloway, yet "*Cock o' the North*" passed the top of the rise, $1\frac{3}{4}$ miles out, in $5\frac{1}{4}$ minutes. By Finsbury Park, still climbing, the speed had risen to nearly 40 m.p.h. and the short slightly downhill "breathing space" to Wood Green quickly brought speed up to 54 m.p.h. before we tackled the $7\frac{3}{4}$ mile climb at 1 in 200 to Potters Bar. At Holloway the cut-off had been brought down to about 25 per cent., and through Wood Green it was only about 15 per cent. In fact, it was only when we were halfway up the Potters Bar bank that cut-off was advanced to about 20 per cent. and with this really easy working the sustained speed on the 1 in 200 was 44 m.p.h.—with a 585 ton load! The exhaust beat was quite sharp and clear, but that is largely due to the poppet-valves, which permit of a very rapid and somewhat explosive exhaust.

Thus we passed Potters Bar, $12\frac{3}{4}$ miles, in $20\frac{1}{4}$ minutes, and here the cut-off was brought back to about 10 per cent. Throughout the rest of the journey I never heard the exhaust. We reached 67 m.p.h. through Hatfield and mounted the Woolmer Green bank at a minimum of 50 m.p.h., but on approaching Hitchin signals at danger were sighted and the momentary slackening before they were pulled off caused a slight loss of time.

Still working on 10 per cent. cut-off, some very fine running now followed. Speed rose to 72 m.p.h. through Biggleswade, and then the engine maintained a rate of 69 m.p.h. on the dead level past Tempsford for mile after mile, a remarkable feat on such an early cut-off. The slight rise through St. Neots did not bring the speed below 65 m.p.h., and we were travelling at 70 m.p.h. again at Offord.

The engine was now blowing off steam furiously, showing full boiler pressure, and this despite very easy firing. For Stukeley Bank, nearly four miles at 1 in 200, cut-off was advanced to 15 per cent. We simply stormed up, going over the top at 54 m.p.h. with steam still blowing off. Back came the cut-off to about 10 per cent., and we ran down the Abbots Ripton bank at 73 m.p.h.

Now came a most extraordinary feat. When we reached the level at the foot of the bank, steam was shut off altogether, as we were well on time, and the valves were put into mid-gear. We ran like this for five miles on the level and at the end of these miles were still running at 54 m.p.h.!

A long slowing to 30 m.p.h. for permanent way repairs was in force through Yaxley, but we came into Peterborough, $76\frac{1}{2}$ miles from King's Cross, in 85 minutes, the net time being about 82 minutes.

Perhaps the finest feat yet achieved by the engine is a "flying" ascent of Stoke bank, the 10 miles of this incline, with a gradient of 1 in 200 to 1 in 178, being climbed at a minimum speed of $50\frac{1}{2}$ m.p.h. with 650 tons! The engine's remarkable hill-climbing ability will be of incalculable value on the Edinburgh to Aberdeen route, and we hope to include in an early issue an account of a footplate trip on this service.



The Growth of Empire Air Mails

Of all the developments now taking place in civil aviation, none is more remarkable, or more important, than the growth that continues to be recorded in the volume of air-mails along our Empire routes to Africa, India, and the East. Each week approximately 50,000 letters now leave London by the Indian air-mail, while the total by the service to Africa has grown to more than 30,000 letters a week, and is increasing constantly.

One of the greatest romances of modern transport has been the extension, link by link, of these trunk air-lines that now stretch for thousands of miles across the Empire. In July, 1933, the India service was carried on to Calcutta; in September another section was opened to Rangoon; and three months later yet another link was forged to Singapore. Recently the Australian Government accepted the tender of Qantas Empire Airways, an associated company of Imperial Airways, for the operation of the additional 4,400 miles which, towards the end of this year, will carry this great air-line on to Brisbane, thus enabling an air-mail service covering a total distance of 13,000 miles to be operated regularly between England and Australia.

When the first air-mail was started to India five years ago, the time between London and Karachi was 7½ days. Soon afterwards, when sufficient experience had been gained, the schedule was reduced to six days. Now, with the summer timetables of this year, India is within five days of London, and faster services to Africa have shortened from 10 to nine days the 8,000-mile air journey from London to Capetown.

A great increase in time-saving has become possible, as a result of these accelerations, in the transport of letters along the Africa, India, and Eastern routes. To Baghdad the saving over surface transport is now from three to four days; to Delhi it has become as much as nine days. To Calcutta the saving amounts to 10 days, and to Singapore 14 days.

On the African route, comparing air and surface times, the flying mail now saves from six to nine days to Khartoum, eight to Capetown, 10 to Johannesburg, and from 10 to 21 to Nairobi. Yet the cost of sending a half-ounce letter by air-mail to British East Africa, where it may arrive three weeks ahead of mails that go by sea, is not more than sevenpence.

Two More Atlantic Flights

In May last Mr. George Pond, an American pilot, and Mr. Cesere Sabelli, an Italian pilot who is now a naturalised American, made an Atlantic flight from the Floyd Bennett Field, New York, to Lahinch in County Clare, Southern Ireland, in a Bellanca monoplane named "*Leonardo da Vinci.*" They had hoped to reach Rome, but conditions were very unfavourable and they took 32 hours to reach Ireland.

Another Atlantic flight, but in the opposite direction, was made in the same month, the aviators this time being the well-known French pilots M. Paul Codos and M. Maurice Rossi. They flew from Le Bourget Aerodrome, Paris, to the Floyd Bennett Field, New York, in their Bleriot machine "*Joseph Le Brix.*" They had intended to fly to San Diego, and if possible to San Francisco, in order to beat their own world record for distance made in August last year in a flight from New York to Ranyak in Syria. They were unable to realise their ambition owing to fog and engine trouble, but they are the first two pilots to fly the Atlantic twice together in the same aeroplane.

Berlin-London Record Flight

The flight from Berlin to London was recently accomplished in the record time of 3 hrs. 50 min. by a Junkers Ju.52 of Deutsche Luft Hansa.



The Curtiss "Falcon" used by the United States Army Air Corps, to whom we are indebted for our photograph.

Faster Air Travel to the Continent

Further accelerations have recently been made in the Continental services of Imperial Airways Ltd. Le Touquet is now only an hour from London by air, and Ostend only a little over an hour. Passengers leaving the London airport at tea-time are in Berlin in time for dinner; while Switzerland is reached in 5½ hours, and Copenhagen in 7¾ hours.

From London regular air connections are available with 60,000 miles of European air-lines, and flights can be made to more than 150 towns and cities throughout the Continent, approximately half of these now being within a day of London. Flying to Paris in the morning, it is possible to spend nine hours in the French capital and return to Croydon by 9.30 the same night, dining in the air during the return trip. Another facility for air travellers this summer is the ability to make week-end trips to Paris without passports.

From Hull to Amsterdam by Air

A daily service between Hull and Amsterdam is now operated in each direction by the Royal Dutch Air Lines. A machine leaves Hull at 1.25 every afternoon and arrives at Amsterdam at 3.40; while the machine in the opposite direction leaves Amsterdam at 1.30 and arrives at Hull at 3.20. This service provides a welcome alternative to travellers from the North of England, who are now able to make the journey by air from Hull, instead of having to proceed via London. As mentioned in last month's "*M.M.*," a special service between Hull and Liverpool has been put into operation to connect with the K.L.M. services.

The airport of Hull is a municipal aerodrome. It was licensed by the Air Ministry on 7th October, 1919, and officially opened three days later by Prince George. It is some 200 acres in extent, and is less than 20 minutes' car ride from the centre of the city. Its close proximity to the docks and to the Humber makes it easy to find by visiting aircraft.

New Short Air Liners

Two huge new air liners built by Short Bros. (Rochester and Bedford) Ltd., have been added to the fleet of Imperial Airways Ltd., and named *"Scylla"* and *"Syrinx."*

The general external design of these machines follows closely that of the "Scipio" flying boats that have been operated for some years on the Mediterranean section of the Empire routes. They are land planes of all-metal construction, except for the wing covering, which is of fabric. Four Bristol "Jupiter" engines are mounted abreast in the gap between the main planes, and drive four-bladed airscrews. The liners are 83 ft. 10 in. in overall length, and 29 ft. 6 in. in overall height with the tails down. They are sesquiplanes, the upper wing having a span of 113 ft., and the lower of 92 ft. 6 in. There is accommodation for 39 passengers, and the maximum permissible all-up weight is 14.3 tons, with which a speed of 130 m.p.h. can be attained.

An unusual feature of the layout of the new type is the large proportion of the fuselage space that is occupied by the cabins. In the extreme nose is the pilot's cockpit with accommodation for the Captain, First Officer and, on long journeys, the Wireless Operator. When the machines are serving on the London-Paris route the Captain or First Officer operates the radio set. Immediately aft of the cockpit is the forward cabin, which has seating accommodation for 10 passengers. The seats are arranged facing each other, six on one side and four on the other. There are large tables between the seats, with a gangway down the middle.

Aft of this cabin is a large compartment with a baggage hold on the starboard side. On the port side is the kitchen, which is provided with every facility for serving meals. The equipment includes ice chests, fruit racks, wine cases, sink, cupboards, and so on, and there is plenty of room for two stewards to prepare meals simultaneously.

This compartment is followed by the aft cabin, arranged in a similar manner to the forward cabin, but larger and seating 29 passengers. Access is gained by a door on the port side, and there is a small lobby at the entrance that prevents undue crowding of passengers as they enter the saloon.

The windows in both cabins are exceptionally large and allow a clear view from every seat, and in dull weather extra lighting is provided by dome lights in the roof. There are electric lamps over each table, and above the windows are racks for light parcels. The cabins are each 11 ft. 9 in. in width, and the first impression on entering either of them is that of spaciousness. They are both scientifically heated and ventilated, and each passenger can control the amount of hot and cold air passing round him.



A three-quarter rear view of the German Raab-Katzenstein R.K.25, a popular low wing monoplane that seats two and has a cruising speed of 90 m.p.h.

A New Altitude Record

A new world altitude record for an aeroplane fitted with a heavy oil compression ignition engine has been made by a Westland "Wapiti" machine fitted with a Bristol "Phœnix" engine. The aeroplane attained a height of approximately 28,000 ft., and both it and the engine behaved perfectly throughout the flight. The fuel burned without difficulty even at the highest point reached, when the temperature was –40°C. The Westland "Wapiti" employed was not of special manufacture, but was a standard two-seater carrying ballast in the rear cockpit in place of an observer. The pilot was provided with oxygen breathing apparatus, and the cockpit was electrically warmed.

The Gloster "Gauntlet"

The latest version of the Gloster "Gauntlet" single-seater fighter, powered by a Bristol "Mercury VI.S" engine, has been adopted as the standard Day and Night fighter of the Royal Air Force. This machine has a remarkable rate of climb and can attain an altitude of 15,000 ft. in 6¼ min.; and at 15,800 ft. it has a maximum speed of 228 m.p.h. The service ceiling is 33,500 ft. The engine develops 605 h.p. at 2,400 r.p.m., and is equipped with a combined Townend ring and exhaust collector. The machine is provided with night flying equipment, wireless reception and transmitting apparatus.



The Basson "Rubis" two-seater high wing monoplane, an experimental all-metal type that has been produced in France. It is equipped with a 40 h.p. Salmson engine.

Air Service to the Orkney Islands

A special article in last month's *"M.M."* was devoted to the internal air services of Great Britain. Since that article was written we have received details of the services to the Orkney Islands that are operated by Highland Airways Ltd. The first of these services to be opened was from Inverness to Kirkwall, but this has now been supplemented by a service that connects Kirkwall, the Outer Orkney Islands and Thurso, while there is still another service from Aberdeen to the Shetland Islands by way of Wick and Kirkwall. It is interesting to note that the services of Highland Airways Ltd., are the first in this country to carry mails.

The Orkney services undoubtedly meet a real need, as in the ordinary way the journey is a long one. By surface transport it is necessary to travel by train overnight to Inverness, and proceed to Thurso by a train leaving at 6.30 next morning. The turbulent Pentland Firth has then to be crossed by boat, and in spite of its shortness the crossing can be a terror to those who suffer from seasickness. Kirkwall is finally reached at 5 p.m., 10 hours after leaving Inverness. By air transport a passenger leaves Euston, London, at 7.30 p.m., arrives at Inverness at 9.50 next morning, and leaves by air from Inverness airport at 10.15. Wick is reached in 55 minutes, and Kirkwall 25 minutes after leaving Wick. The Kirkwall-Thurso route links up the islands of Westray, Sanday, Stronsay and North Ronaldshay.

The Aberdeen service operates from Seaton Aerodrome, and is flown once a day, leaving at 10.15 a.m., and reaching Wick by way of Lossiemouth and Berriedale. After a brief stop at Wick, Kirkwall is reached about midday, and the return flight is commenced at 4.15 p.m. Full details are not yet completed with regard to the extension to the Shetland Islands.

A great feature of these services to the Orkney Islands is the wonderful scenery en route. On a fine day there are to be had glorious views of the Moray Firth, the mountains of Caithness and Sutherlandshire, Tarbatt Ness promontory, Scapa Flow, and of course the islands of the Orkney group.

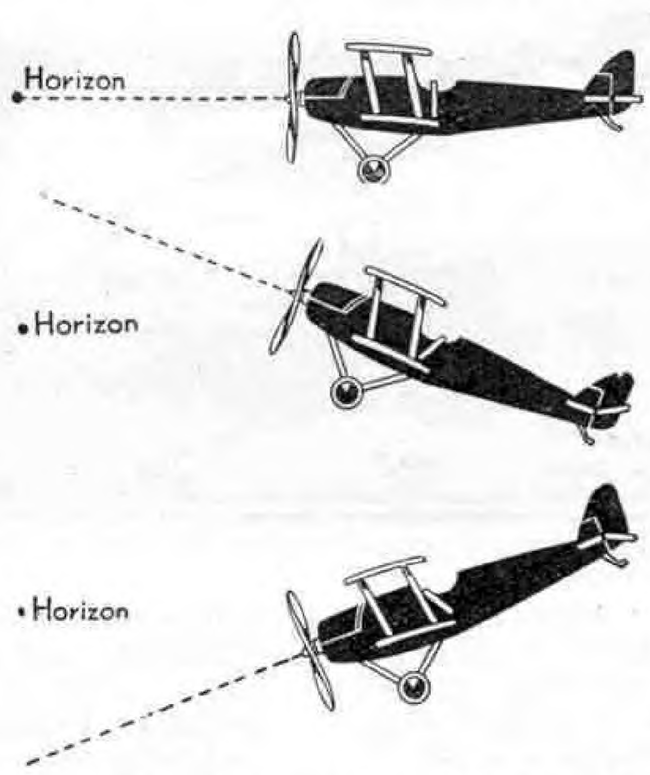
Skegness-Nottingham Service

The daily service between Skegness and Nottingham operated by Eastern Air Services last summer was reopened on 1st July last. An extension to Leicester will be put into operation as soon as the aerodrome there is ready. Last year the service carried a total of 428 passengers.

How an Aeroplane is Flown

The Controls and Instruments

AEROPLANES are now thoroughly familiar to most of us, and aviation occupies a considerable amount of space in our daily newspapers; but in spite of this certain misconceptions are still very widespread. Many people appear to have what the psychologists delight to describe as an "inferiority complex" in regard to flying. Such people talk as though air pilots were in some way superior beings, capable of exploits far beyond the capabilities of the man in the street. The fact is that any man or woman of normal physical and nervous condition is capable of learning to fly. The physical strength required to operate the controls of an aeroplane is considerably less than that required to handle a motor car; and the nervous strain of flying is certainly far less than that experienced by the driver of a car on any average road.



Diagrams showing how an aeroplane is controlled by means of the control column or "joy-stick" operating the elevators.

The fear that a feeling of dizziness will be experienced in an aeroplane is quite unfounded, for in normal flying the sense of height that one experiences in looking over the top of a high cliff is completely absent. Some people feel at first a slight discomfort when an aeroplane is gliding down to land, but except with a few abnormally sensitive people this feeling completely disappears after two or three flights. In short, the only people who are afraid of flying are those who have never flown.

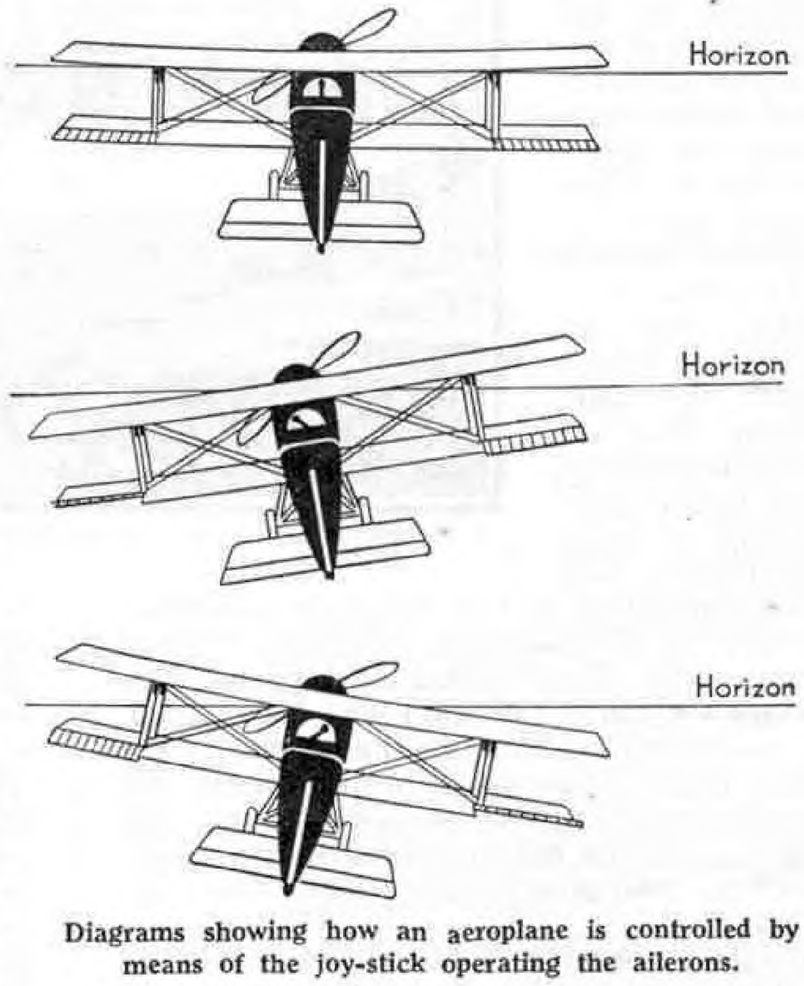
Accidents occur in flying as in every other form of transport, and there is certainly a slight element of the sensational about a crash, of which some newspapers take the fullest advantage. Actually, however, flying is far safer than motoring; and whereas motoring becomes more and more dangerous as road congestion increases, flying becomes steadily safer as machines and engines are improved in strength and reliability.

It is an interesting fact that an expert motorist does not necessarily make a good air pilot. In controlling an aeroplane there is required a delicacy of touch that is almost completely absent in the handling of a car, and many experienced car drivers are definitely "ham-handed" in the air. Other things being equal, the most apt flying pupil is probably one who is a more or less expert horseman.

In this article we shall give a brief description of the essential parts of an aeroplane, and of the manner in which it is controlled.

The central portion of an aeroplane is the long body or fuselage that houses the cockpit or cabin for pilot and passengers. The engine is usually placed at the front end of the fuselage, except in multi-engined aeroplanes, in which the power units are carried in nacelles, or egg-shaped casings secured underneath the wings, or in some types on top of them. In a single-engined machine the plane or planes are usually situated a short distance behind the engine. The rear of the fuselage carries the tail unit or empenage, which is made up of rudder, fin, elevators and tailplane. Below the front portion of the fuselage is the undercarriage, which may be provided with wheels or with floats.

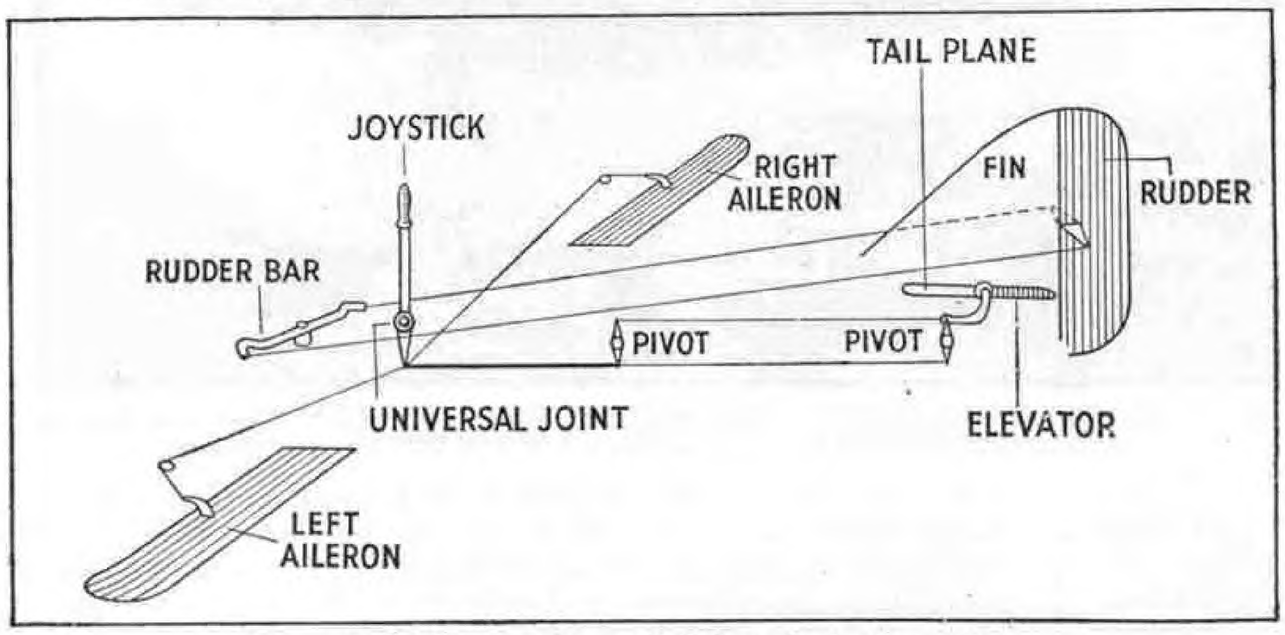
The parts just mentioned are made of a variety of materials. The fuselage may be a metal structure, or may consist of a wooden framework covered with three-ply. In almost every machine the mounting for the engine is of metal. There are many types of engines, but they may be divided into two main classes according to whether they are cooled by air or by water. Air-cooled engines are of the radial type, in which the cylinders are arranged radially to the crankshaft, or of the in-line type in which the cylinders are placed one behind the other. Water-cooled engines usually have the cylinders divided into two or three "banks" or lines, and arranged either in a V or W form.



Diagrams showing how an aeroplane is controlled by means of the joy-stick operating the ailerons.

The main planes and the fuselage may be of either wood or metal construction. If of wood they are almost certain to be covered with fabric that has been treated with a special preparation or "dope" after fitting, in order to make it as taut as possible. Metal wings often consist of a metal framework covered with fabric, but sometimes metal is employed even for this covering. A wood and fabric structure is easier to repair than one of metal, and is the form now in general use.

Everyone who examines an aeroplane for the first time is struck with the simplicity of the manœuvring mechanism, everything being done by three levers. The first lever, the control column or "joy-stick," which looks rather like the gear lever of a motor car, is connected to two controls, the ailerons and the elevators. The ailerons are small movable flaps arranged along the rear or trailing edges of the wings. In biplanes ailerons may be fitted on only the two lower wings, or on all four of them. The elevators forms one of the two main parts of the tail unit.

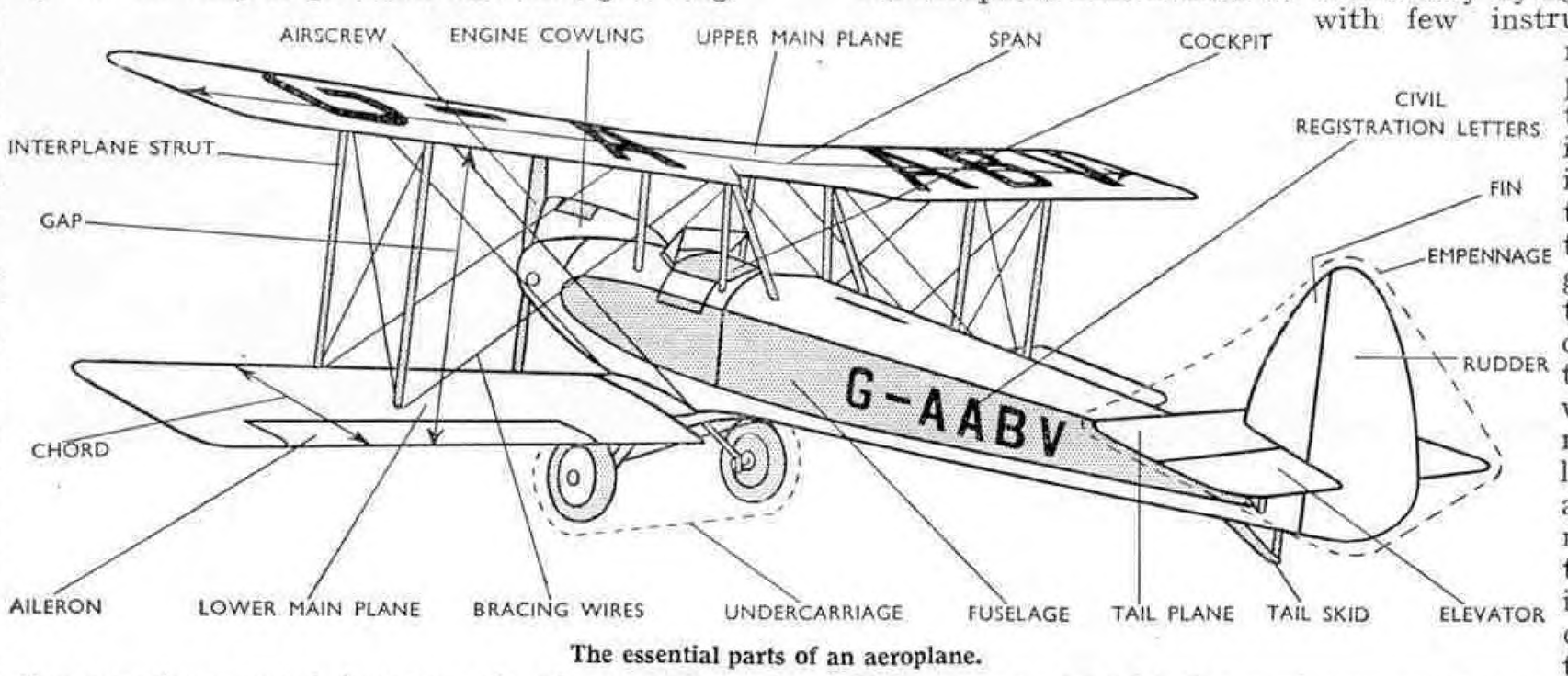


The controls of an aeroplane and their methods of operation.

The second lever, the rudder bar, is arranged on the floor of the cockpit, and is operated by means of the feet, one foot being applied at each end. This bar is connected with the rudder, which is the second main portion of the tail unit. The third lever is the throttle control. In British machines this is always placed on the left-hand side of the cockpit, except when it is necessary for the lever to be operated from either of two seats arranged side by side in the cockpit, in which case it is placed between the seats.

The joy-stick is the most fascinating factor in the control of an

aeroplane. In order to fly the machine level, the stick is kept in a central and vertical position. If it is moved forward the elevators are depressed, and the machine puts down its nose and begins to dive. If the stick is pulled backward, the elevators are raised and the machine lifts its nose and rises. Movement of the stick from left to right brings the ailerons into action. If it is moved to the left the ailerons on the left side are raised and those on the other side lowered, causing the left wing to go down and the right wing to rise. If the stick is moved to the right the right wing drops. This raising and lowering of the wings is termed "banking."



The essential parts of an aeroplane.

If the aeroplane is veering or "yawing" to the left, right rudder is put on by moving the right foot gently forward; similarly veering to the right is corrected by applying left rudder. The rudder must not be used alone to turn the aeroplane round, however, for the machine would then skid in a somewhat similar manner to a motor car racing round a bend on an unbanked road. It is impossible to bank the air, and therefore the aeroplane is banked instead. That is to say, rudder and bank are applied together in the direction in which it is wished to turn.

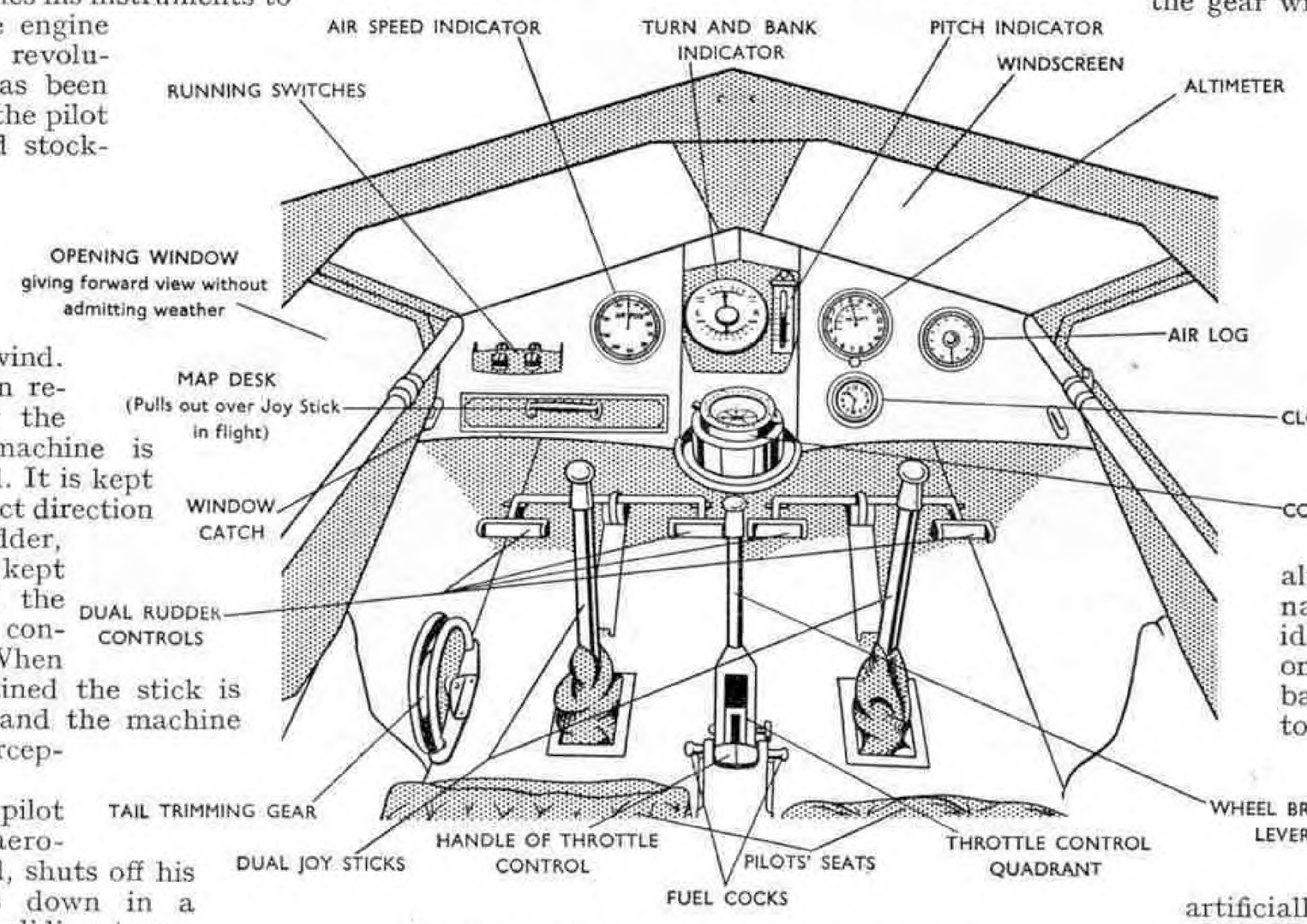
The throttle control in the cockpit is used to vary the speed of the machine. It is connected with the carburetter of the engine, and if it is pushed forward the throttle is opened and more petrol is admitted into the cylinders of the engine. Consequently the propeller turns quicker and the machine goes faster. When it is desired to slow down, the throttle control is pulled back.

A pilot always "warms up" his engine before taking off. At first the engine is run at a comparatively slow speed, but when the temperature indicator on the dash-board shows that the correct temperature has been reached, it is run "all out" for a few seconds while the pilot watches his instruments to make sure that the engine is making its full revolutions. When this has been done satisfactorily, the pilot glances at the wind stocking, which is a canvas cone raised on a mast in some prominent part of the aerodrome, to determine the direction of the wind. The chocks are then removed from under the wheels and the machine is taxied into the wind. It is kept pointing in the correct direction by means of the rudder, the stick being kept slightly forward of the point at which all controls are neutral. When flying speed is attained the stick is eased gently back, and the machine rises almost imperceptibly into the air.

In landing, the pilot approaches the aerodrome into the wind, shuts off his engine, and comes down in a glide or a series of gliding turns. When the machine is 15 ft. or 20 ft. above the ground the glide is eased by pulling the joy-stick slightly backward. Then, at about 2 ft. from off the ground, the stick is gently pulled still further back until the aeroplane is in such a position that it lands with the wheels and the tail skid touching the ground together.

The aeroplanes used for elementary training purposes have two cockpits, one in front of the other, the controls in each being interconnected. This arrangement enables the pupil in the rear cockpit to follow all the manipulations made by the instructor in front, and also allows the instructor to correct any mistakes made by the pupil. Communication between instructor and pupil is maintained by means of earphones attached to their helmets and to tubes that are plugged into connections in both cockpits. A safety belt is fastened round the body with a pin fastening that can be undone instantly in case of emergency.

An aeroplane that is used for elementary flying is usually fitted with few instruments, as the newly-fledged pilot is only interested in keeping his machine in the air. The two instruments that he finds of greatest use are the airspeed indicator, which tells the speed at which the machine is travelling through the air, and the altimeter, which gives the height. Next in importance comes the revolution indicator, to tell the speed at which the engine is running, and the oil pressure gauge and oil thermometer. With these, and of course running switches for the engine, it is possible to make flights for long distances in good weather.

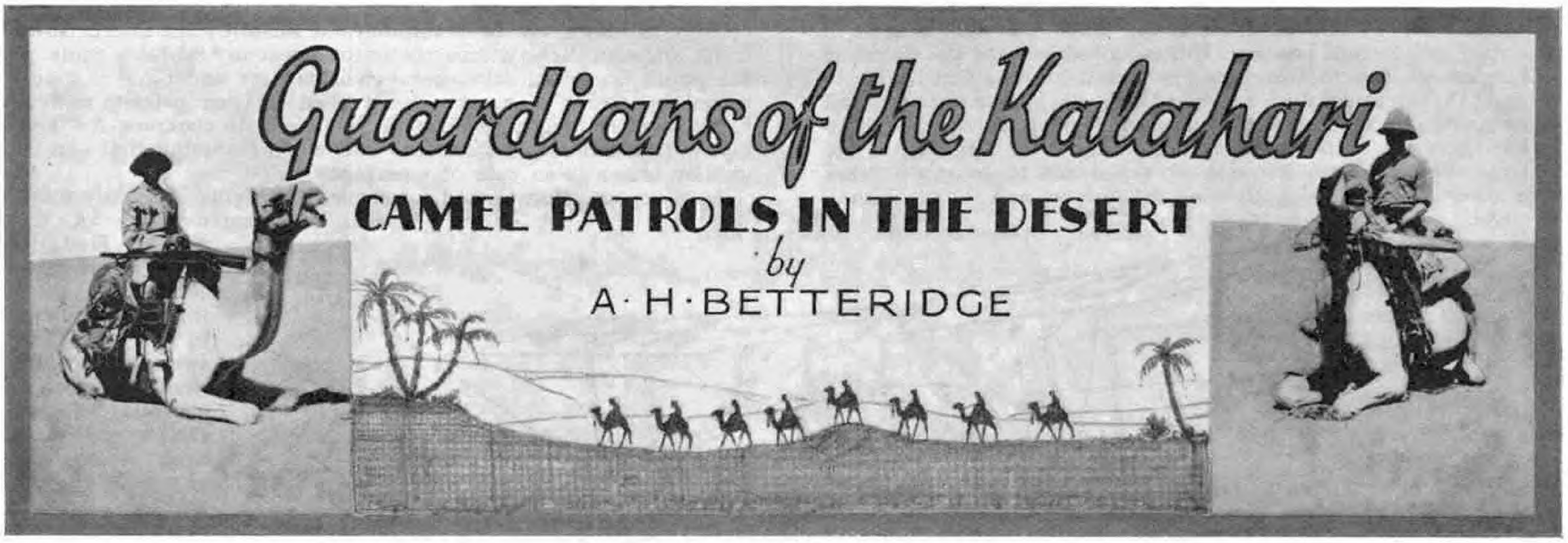


The interior of the cockpit of a General "Monospar."

When the pilot becomes more experienced, however, he will require additional instruments. If he intends to fly more than a few miles from the aerodrome in anything but the best weather he will need a compass, while a turn and bank indicator is also of great value for it shows the exact angle that the machine is taking when banking. This instrument is absolutely necessary if any flying is to be done in bad weather, and among clouds, as is also an indicator to tell the "pitch" or angle of climb or dive of the machine. Most aeroplanes are now also fitted with what is known as tail adjusting gear to alter the trim of the control surfaces during flight so that a pilot need not hold the elevators up or down for long periods. For instance, if a long steady climb is being made, the gear will be adjusted so that the tailplane keeps the machine climbing at a steady angle without any necessity for the pilot to keep a firm grip on the joy-stick.

In flying under normal conditions the pilot of a civilian machine does not usually pay a great deal of attention to his instrument board. He must of course occasionally glance at the airspeed and revolution indicators and the altimeter, but he usually navigates his machine by identifying landmarks noted on a map. The turn and bank and the pitch indicators are required when a flight is being made "blind." This condition may be brought about either artificially, for training purposes, when a hood is placed over the rear cockpit of a double cockpit machine; or naturally, when flying in fog, cloud or mist. When a pilot is flying blind, all his normal senses of direction and position appear to desert him, and he has to fly entirely by following the "directions" of his instruments.

When a pilot is undertaking a blind flight he first works out his course. If, for instance, he is given a triangular course to fly, he calculates the distance between each of the three points, the compass directions in which they lie, and the time *(Continued on page 680)*



MANY South African Railways and Harbours road motor services undertake schedule trips to little-known parts of the backveld, but probably the most extraordinary routes in the Union are those radiating from the historic town of Kuruman, famous as the site of the mission station of Dr. Robert Moffat. Two of the road motor routes extend to the fringe of the Kalahari desert, where the South African Police posts are equipped with mounts not usually seen in South Africa. At Morokwen and Oliphantshoek the mobile transport of the Railway Administration may be seen travelling alongside camels that seemingly regard all forms of wheeled transport with contempt.

There are 11 police posts in the Kalahari equipped with camel mounts, and about 60 officers and men comprise the Kalahari Camel Corps, though officially they are merely designated South African Mounted Police. Some of the desert police outposts are as lonely, and probably as romantic, as the better-known outposts of the North-West Mounted Police of Canada.

The extreme south of the Kalahari is sparsely populated by hardy pioneer farmers who have built picturesque homesteads round the few boreholes where water has been found. A large area on the fringe of the desert proper has been proclaimed a game reserve, and hordes of antelope of all kinds roam among the sunscorched grass and shelter beneath mimosa and camelthorn trees. A most important duty of the camel police is to prevent poaching in the game reserve, and this is no light task, as the desert bushmen are skilled hunters with their primitive bows and poison-tipped arrows. Though cunning and resourceful, bushmen fear the game guardians and their "horses with long legs," and they have learned to appreciate that white policemen possess an uncanny knowledge of veldcraft, and can read spoors, no matter how well camouflaged by the wily diminutive black nomads of the sands.





The upper photograph shows a patrol of camel police on its return after 26 days in the desert. Below a patrol is seen ready for duty. Photographs reproduced by courtesy of the "South African Railways and Harbours Magazine."

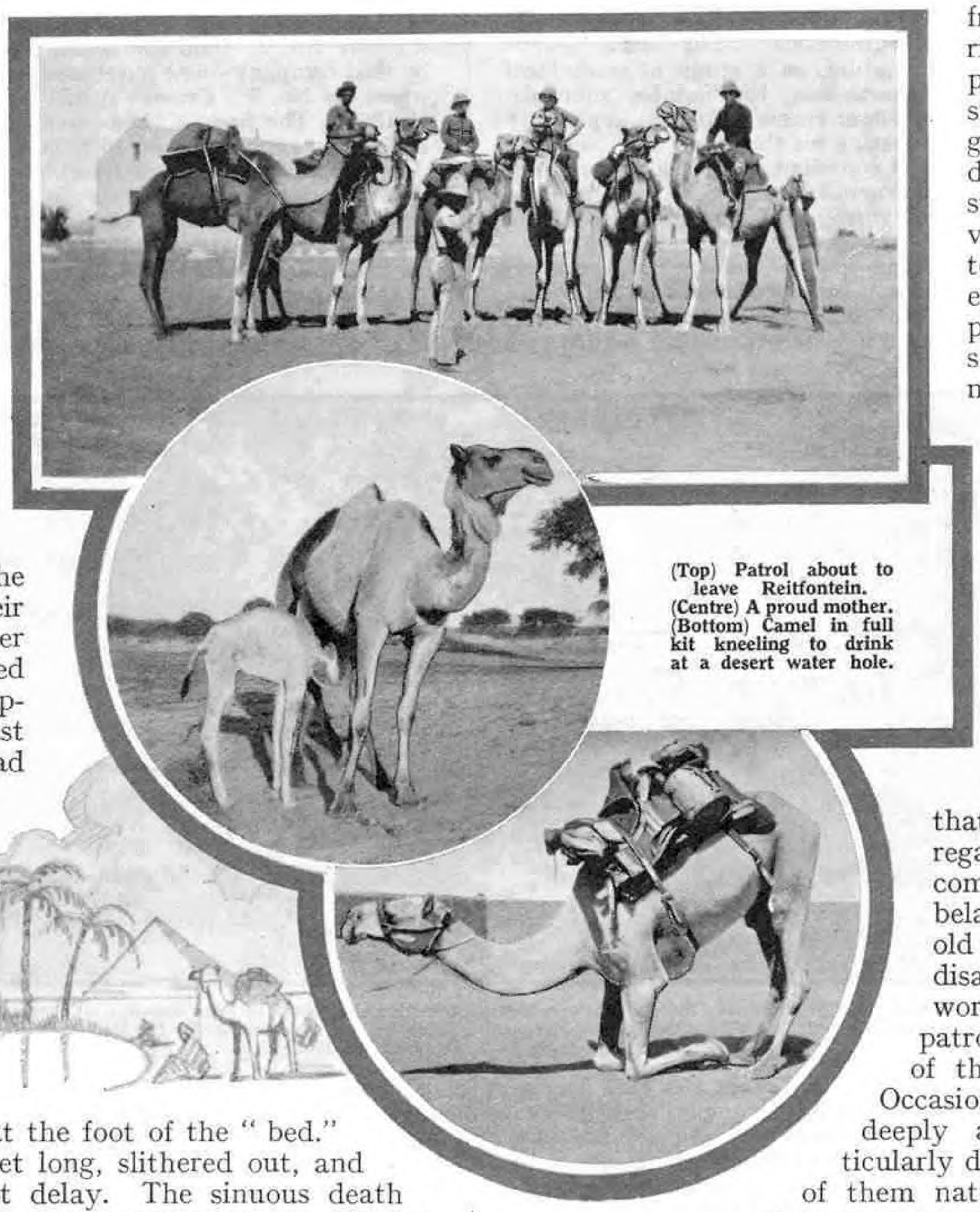
Eight of the 11 camel posts are situated on the banks of dried river beds whose courses are clearly indicated by camelthorn trees on the banks. Water is found by digging in the dried beds, and where the supply is not brackish, rondavels and kraals have been built. Camel posts boast such names as Bushmanspits and Obobogorop, the latter meaning in the Bushman tongue, "Where the antbear bored for water."

The longest patrol in the desert lasts nearly a month and the camels are specially trained to control their thirst. At the posts a daily ration of water is available, but when a beast had accustomed itself to a daily drink it would die without water after three days unless gradually weaned.

At Christmastime the temperature in the desert rises to 120 in the shade—not that there is any shade—and camels often refuse to stir on account of the heat. When in the heart of the sands, away from civilisation, members of a patrol wear nothing but

shorts, shirt and shoes. Common-sense overrides regulations and red tape. What meat they obtain depends on their success with the rifle, and the fierceness of the sun necessitates immediate cooking. For the same reason, bread is baked as required; a waterproof sheet is usually used for mixing the dough, which is baked on flat stones.

In spite of the mid-day heat, it is often bitterly cold among the sand dunes at night-time, and no patrolman will camp at night without a fire to ward off wild beasts. But snakes are the worst enemies. They love to sun themselves on the dunes, and often object to the approach of a camel and its rider. Policemen carry a whip for the specific purpose of decapitating reptiles without having to dismount. At night snakes sometimes crawl alongside the body of a camel for warmth, and the camel police take the precaution of folding their blankets in such a manner as to prevent an unwanted visitor becoming a sleeping companion. Last year a constable who had taken the usual precautions awoke with a feeling that all was not as it should be. Suspecting the worst, he conveyed his suspicions to his companion. He remained rigid while his pal raised the blanket at the foot of the "bed." A yellow cobra, four feet long, slithered out, and was despatched without delay. The sinuous death must have crept in at the opening of the blanket round the policeman's neck without disturbing the sleeper.



(Top) Patrol about to leave Reitfontein. (Centre) A proud mother. (Bottom) Camel in full kit kneeling to drink at a desert water hole.

Camels are brainless beasts and appear to suffer a perpetual grievance. They have been known to lie foolishly complaisant while a jackal viciously disemboweled them; after seeing a snake rear at them they will deliberately cush down to receive a fatal bite. There is only one denizen of the desert that causes a camel to flinch, and that is a lion. Hearing a roar from the king of beasts, a camel will always bolt, trembling and utterly beyond control; yet it will not flutter an eyelash at the sight of a leopard or wild dog. Last year a large leopard was seen in the vicinity of the post at Oliphantshoek. A camel policeman wounded the marauder at dusk, and was severely mauled by the infuriated beast before a companion could kill it.

Only one policeman has been lost in the desert. It happened many years ago. The unfortunate man was not attached to the regular camel section, but was riding a horse from Nakop to Reitfontein. Intending to fringe the desert dunes, for some unknown reason he crossed them. Four days later his horse returned to the post riderless, with full equipment except one stirrup. The significance of half-full waterbottles still attached to the saddle caused a search party of mounted men to be despatched immediately, and they found the body late next day. Apparently the horse had taken fright and thrown its rider, who clung desperately to one stirrup until the strap gave way. The evidence of a dramatic struggle was plainly visible in the sands to the experienced eyes of the camel patrolmen. Spoors showed that the maddened horse had dragged the doomed man nearly three miles; whereafter, injured and without water, he had walked in circles. Scavengers of the desert had mutilated the body.

The absence of social life, the lack of amenities that we have come to regard as essential to comfortable existence, belated mails, month-old newspapers and other disadvantages do not worry these sun-tanned patrolmen unduly. Some of them love the desert. Occasionally they become deeply attached to a particularly docile camel, but most of them naturally prefer horses, because they are more companionable than camels.

While we are discussing the subject of transport, who knows but what the South African Railways and Harbour road transport drivers may run scheduled trips into the desert at some future date? One road transport officer was heard to remark that a bus would be sent any day traffic justified such a course!

* * * *

We are indebted to the courtesy of the Editor of the "*South African Railways and Harbour Magazine*" for permission to reproduce this article. It will be of special interest to readers who remember the article on the Arab Legion Camel Corps that appeared in the "*M.M.*" for June of last year. Although this Corps is very different in constitution from the Kalahari Camel Corps, it resembles it in working in a desert region, its particular task being to keep law and order among the tribes of Bedouins that periodically infest the region of the Sinai Peninsula.

Some Old London Tank Engines

Suburban Veterans and their Story

THE claims of the purely suburban tank locomotives engaged in hauling short-distance stopping trains are seldom fully recognised even by railway enthusiasts. Their work always appears to be of a humdrum nature, as a study of most local timetables will confirm. Nevertheless, the humble suburban tanks that handle so many rush-hour trains with such apparently monotonous regularity are interesting for their own sake as steam locomotives, and for their useful contribution to the performance of the daily business of their owners. In addition there is often a good deal of history behind them, as a consideration of the engines illustrated will show.

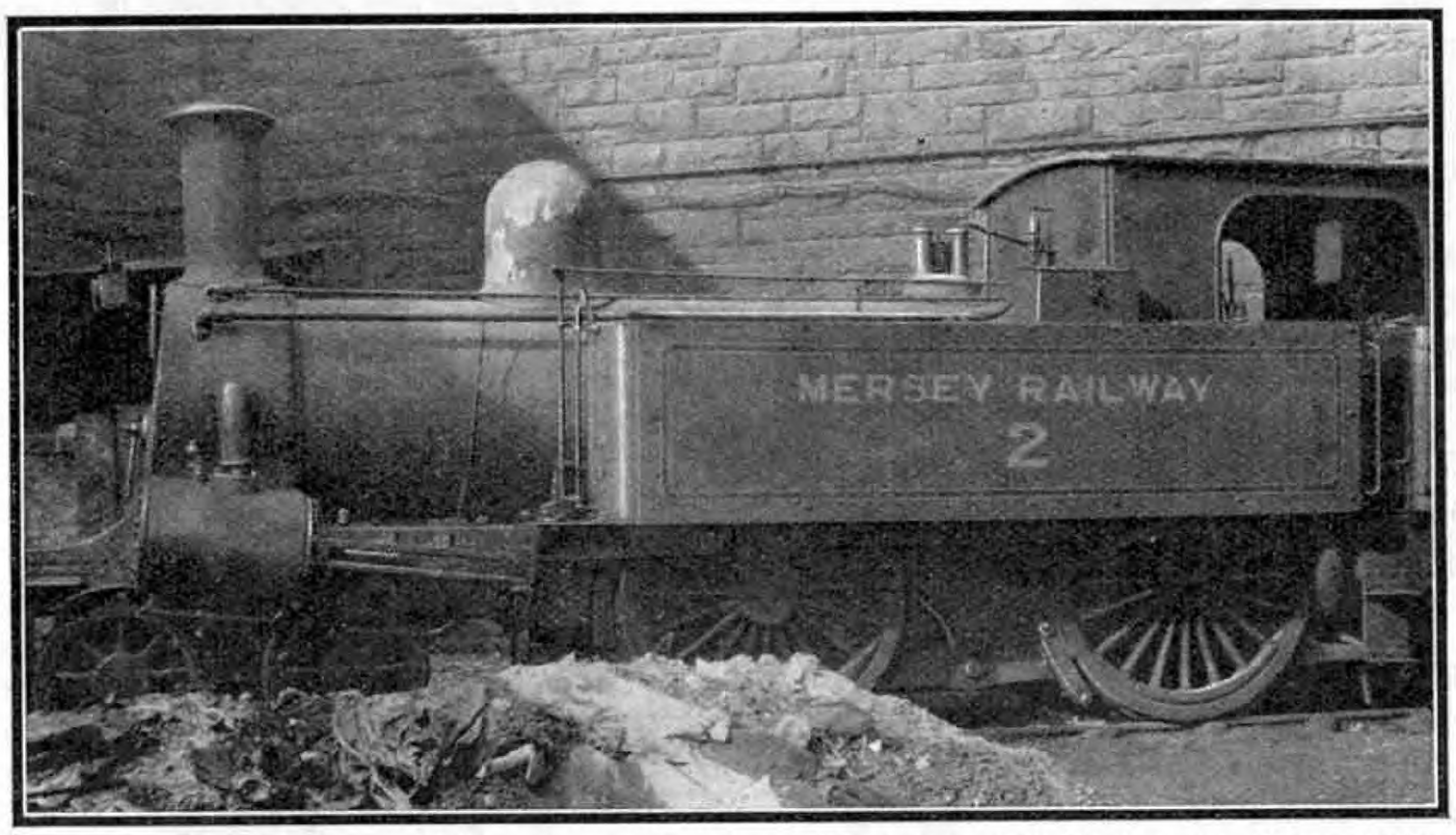
The development of the tank engine has been interesting, although of its origin we need say little. One of the competing engines at the Rainhill Trials of 1829, the "*Novelty*," entered by Braithwaite and Ericsson, was a self-contained vehicle and carried its fuel and water on the same frame as the engine and boiler. It may therefore be regarded as the first tank engine, as distinct from those with a separate tender attached for the conveyance of their fuel supplies. Little attention was paid generally in the early days to tank engines, and there were few examples running.

In 1846 the first engines to be built with side tanks were supplied by the Vulcan Foundry to the Waterford and Kilkenny Railway, and in 1848 the London and Blackwall line obtained some tank engines from the firm of Jones and Potts. During the next few years the tank engine had quite a vogue, and some interesting examples were turned out by various makers. Not only were tank engines used for their designed duties of local and branch line working, but even in those early days light express trains were also hauled by them. Notable examples of express tanks in the London district were the first engines to be built at the Stratford Works of the then Eastern Counties Railway. These appeared in 1850 to the designs of Mr. J. V. Gooch, and finally numbered 25 in all, though there were differences in detail between different locomotives. They worked light expresses between London and Norwich and Ipswich among other duties, and for some time ran on the London, Tilbury and Southend Railway.

Remarkable popularity was at one time enjoyed by the 4-4-0 type of tank locomotive. When the work required was suited to the somewhat limited bunker capacity permitted by this wheel arrangement, a large number of these engines was in use. Heavier duties, both as regards loads and mileage, caused the type to be expanded into the familiar 4-4-2. Very well known to Londoners of 40 years ago were the 4-4-0 tank locomotives of the Metropolitan Railway. The type was introduced on that line in 1863—70 years ago—when Beyer Peacock and Co. Ltd. supplied the first of them to the designs of Mr., afterwards Sir John, Fowler. That they were suitable for the work is shown by the fact that similar engines were supplied to the Midland and L.N.W. Railways for London district work. The L.S.W.R. also had some, but their engines commenced work in 1875 on expresses between Exeter and Plymouth. The Metropolitan District Railway adopted the type, and the North London 4-4-0 tanks, first evolved under Mr. W. Adams and subsequently developed, had many similar features.

Some of the chief characteristics of this "Metropolitan" type of tank may be seen from our illustration of what is now Mersey Railway No. 2—the only steam locomotive at present possessed by that company—and purchased from the Metropolitan Railway, where, as No. 7 "*Orion*," it had been one of the earliest engines of 1863. The first of them, named "*Jupiter*," was scrapped in 1897 after running some 1,050,000 miles. It is interesting that this engine, having ceased locomotive duties, was mounted on blocks and used to generate current for experimental work in view of the approaching electrification of the Metropolitan line. Thus the first Metropolitan steam locomotive also ran the first electric trains of that company.

The illustration shows that outside inclined cylinders drive the leading pair of coupled wheels, and it will be noticed that the slide bar arrangement incorporates four bars to guide each crosshead. No running plate is provided over the slide bars, nor in front of the cylinders, a very bare appearance in this quarter being the result. The leading wheels are closely spaced together under the smoke-box, which has an inclined front, opening upward, as commonly applied years ago. When first built these Metropolitan engines had exhaust pipes passing upward from the cylinders. These developed into chambers housing flap valves, so that the exhaust steam might be diverted by means of pipes of large diameter into the side tanks, and there condensed by the cold feed-water. This condensing was necessary, for one of the statutory conditions imposed when the Metropolitan system was authorised laid down that the locomotives should emit no vapour or smoke in the tunnels, in order to keep the atmosphere as free as possible. The exhaust could if necessary be turned up the chimney in the usual way by manipulation of the flap valves, as would be done when working in the open.



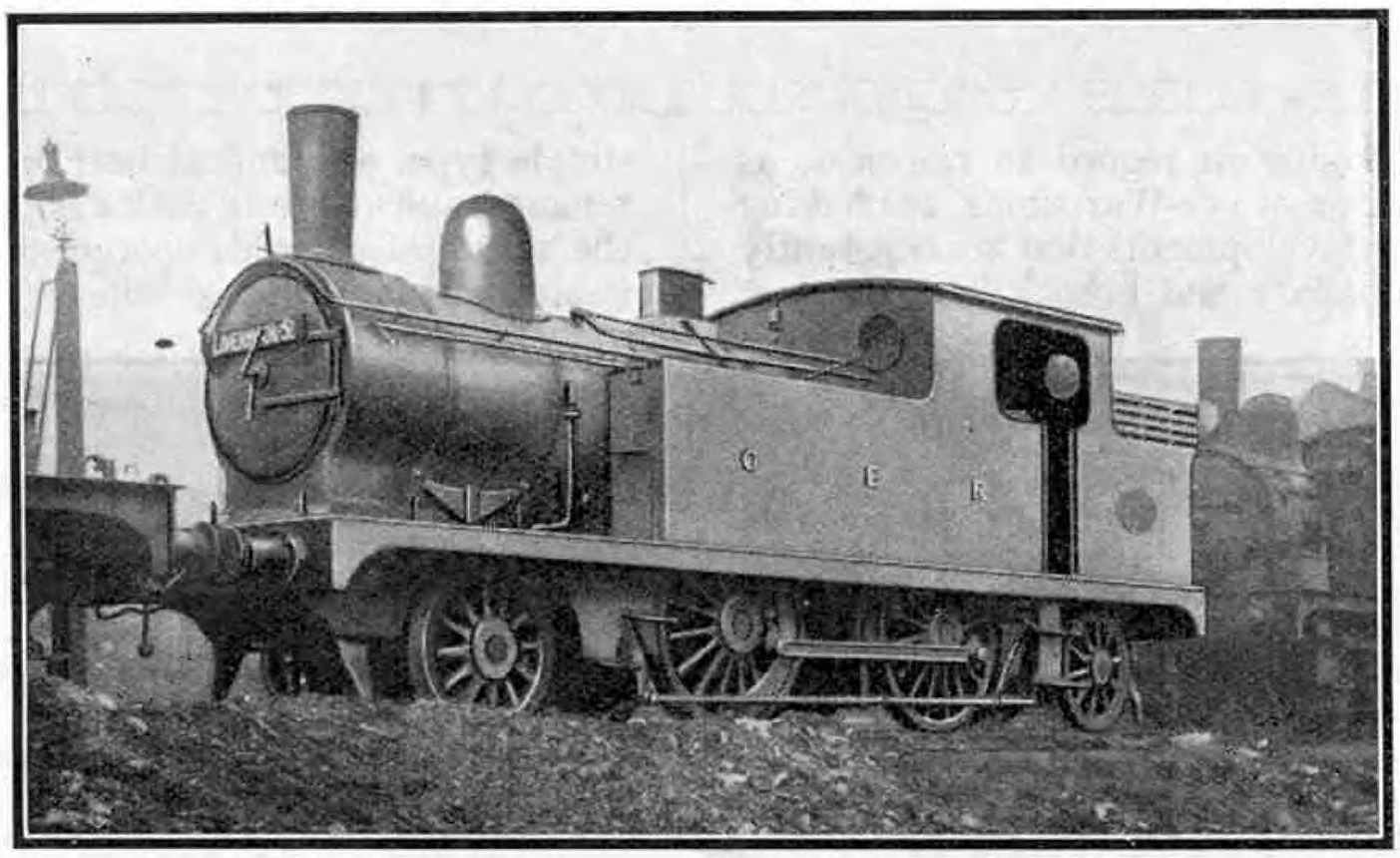
Locomotive No. 2 of the Mersey Railway, the only steam locomotive now owned by this company. It is one of the original engines built in 1863 for the London Metropolitan Railway, and was acquired by the Mersey Railway in 1925. Photograph by C. W. Reed (Birkenhead).

An outlet for any steam from the tanks that might be caused by the condensing water being warmed up was provided by two pipes, which passed up and over the boiler in the form of an arch above the driver's line of vision, and united in a more or less ornamental bell-mouthed fitting. This apparatus has been long since removed from the engine illustrated, and the cab fitted is a later addition, as plain weatherboards only were the rule in the old steam days on the Metropolitan. Similar methods to aid the escape of any steam from the tanks were also used on the District Railway engines. Some of these had cabs when built, but the men did not care for them for tunnel service, and they were removed. It is quite evident that the Victorian drivers were a decidedly hardy race!

Before becoming Mersey Railway property the engine shown had been rebuilt several times by the Metropolitan Company, the last occasion being in 1921. The boiler is not of the original design, for the dome was first situated on the front ring of the boiler, close up to the smoke-box, and was of ornamental pattern with spring-balance safety valves on top. The original chimney, too, was of the familiar "Beyer Peacock" pattern, tapering inward from the base, and provided with a polished copper top. This no doubt looked considerably better than the rather clumsy

cast iron erection now fitted, which appears too heavy for the engine. This locomotive was preceded on the Mersey Railway by a similar Metropolitan engine built in 1884 and acquired in 1907, but later disposed of. Its work is to haul the Engineering Department trains when required during the hours when the electric trains are not running.

Its employment on this work is paralleled by the Metropolitan District engines L34 and L35 that are kept at Lillie Bridge Depot, near Kensington. The first of these is the only really original District steam engine now in use, for L35 was obtained from the Metropolitan Railway some years ago. It was originally built in 1866, and carried the Metropolitan number 22. This latter engine has the same type of chimney as the ex-Metropolitan survivor of the Mersey system, whereas the District engine has the narrower pattern of fitting used on that line, somewhat resembling "Stirling" practice on the G.N.R. It also has the dome close up to the chimney, as in the original design of both Metropolitan and District engines. Both engines now have cabs, and are interesting in that they have trip-cocks fitted that automatically apply the brakes if a signal at danger is passed, in the same manner as the Underground electric trains. These two steam veterans, in addition to their "ballast" duties, also play their part to keep traffic moving when severe frosts cause a coating of ice to form on the conductor rails on open air sections of the line. They are fitted with special "sleet brushes," and patrol the line during the small hours in order to keep the rails free for the electric trains of the next day.



One of the numerous 2-4-2 tank locomotives of the former Great Eastern Railway. This locomotive was one of a series built in 1886. Photograph courtesy L.N.E.R.

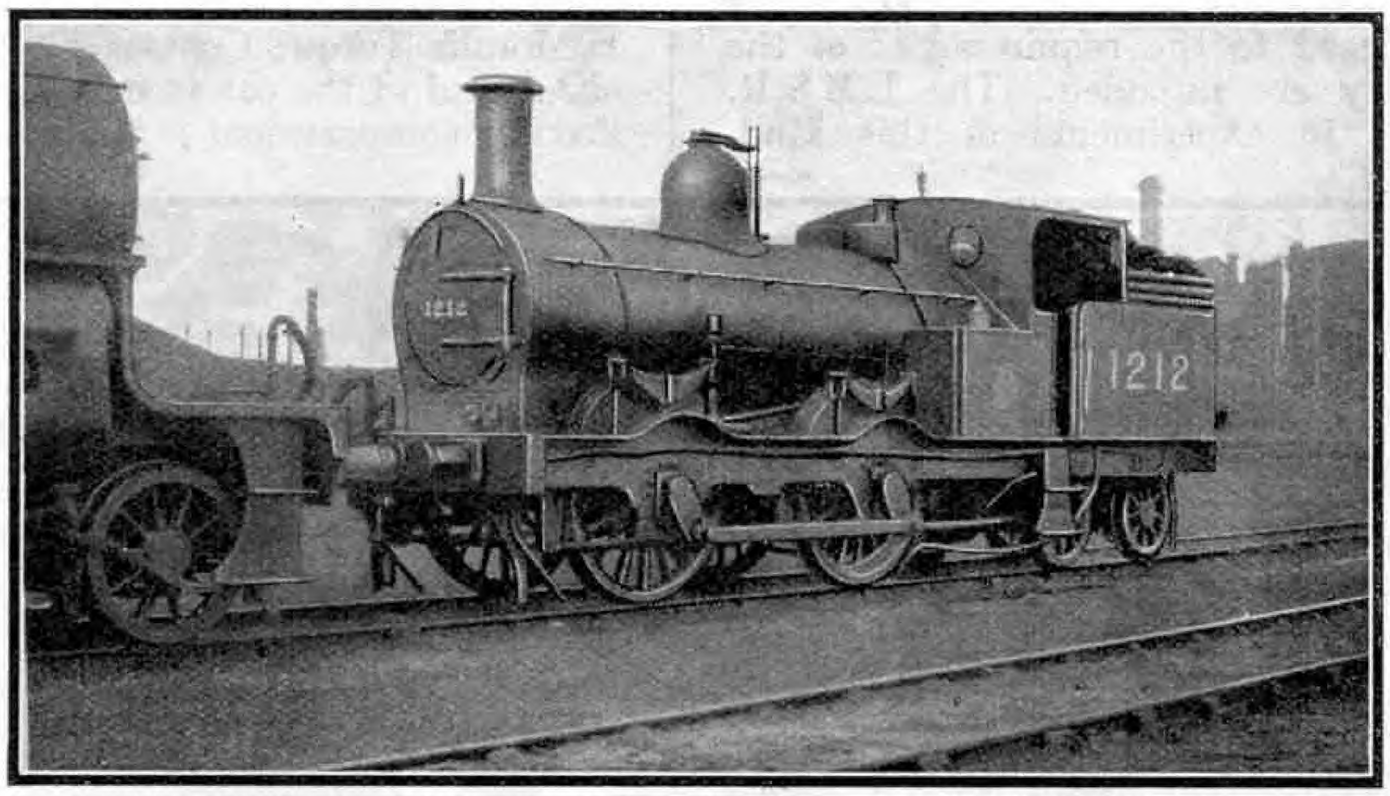
Soon after the completion of the District Railway to Mansion House, a train service was inaugurated in 1872 over what became known as the "Outer Circle," in order to distinguish it from the more familiar "Inner Circle" of the Metropolitan and District railways. This service operated from the Broad Street terminus of the North London Railway through to Kensington by means of Willesden Junction and the West London line, and from Kensington to Earl's Court and the District lines to Mansion House, where the trains were within a few minutes' walk of their starting point. For the tunnel sections condensing engines were necessary, and therefore some of the Metropolitan type tank engines were obtained by the L.N.W.R., who sponsored the service, from Beyer Peacock and Co. Ltd. They were of the standard pattern with no cabs, and of course had the well-known "Beyer Peacock" chimneys, which were retained for about 10 years. They carried the numbers 2055-70.

Subsequently L.N.W.R. chimneys were added, and finally all except one, No. 2063, were rebuilt as 4-4-2 tanks with larger bunkers and cabs and fittings generally of Crewe design. They thus became as "North Western" in appearance as it was possible for Metropolitan engines to be. In their rebuilt form they ended up in the Manchester district on the Manchester South Junction and Altrincham line. The exception referred to above retained the 4-4-0 wheel formation, but fell a victim to Mr. Webb's passion for the compound system of working. In 1884 it was rebuilt as a three-cylinder compound, and was the first tank engine to which the Webb system was applied.

The Midland Railway purchased in 1868 six of the Metropolitan engines then being built by Beyer Peacock's. These were intended for local services between Hendon and Moorgate Street on the Metropolitan. They became Nos. 204 to 209 on the M.R., and as with the L.N.W.R. engines, they too began later to show signs of the owning company's practice, for standard Midland chimneys and other fittings of the period were applied.

Although these engines have been broken up for some time, due no doubt to the fact that they were a small class with material divergences from Derby standards, they have been survived by a class of engines of exactly the opposite wheel arrangement built in 1869 and 1870. These were the famous 0-4-4 engines with outside frames and rear tanks designed by Mr. M. Kirtley. As with his outside-framed goods engines, they must have been very solidly constructed, for examples are still running, and as the lower illustration on this page shows, they bear the evidence of several rebuildings.

The original design appears in the outside frames and cranks and in the timber buffer plank. The inner ends of the springs were originally connected below the frames by equalising beams attached to their hangers, but these have long been removed. The cab was added to the original in Mr. Johnson's time, when he introduced his variety of boiler mountings. These still survive in the dome and safety valve casing, but the Deeley parallel-sided chimney has replaced the handsome tapering Johnson pattern. The smoke-box door, too, is of the later type, secured by dogs round the rim, while the condensing pipes of the example illustrated have been removed. These formerly emerged from the smoke-boxes just below the handrail. They ran along parallel to the latter, and then curved down behind the cab side panel, reappearing outside the frames, but below the footplate, and then turning upward into the bunker tank.



A veteran 0-4-4 Midland tank locomotive with outside frames. It resembles the Metropolitan Railway locomotive shown on the opposite page in having been rebuilt several times, the work of successive Locomotive Superintendents being traceable. Photograph by T. W. Burgess (Liverpool).

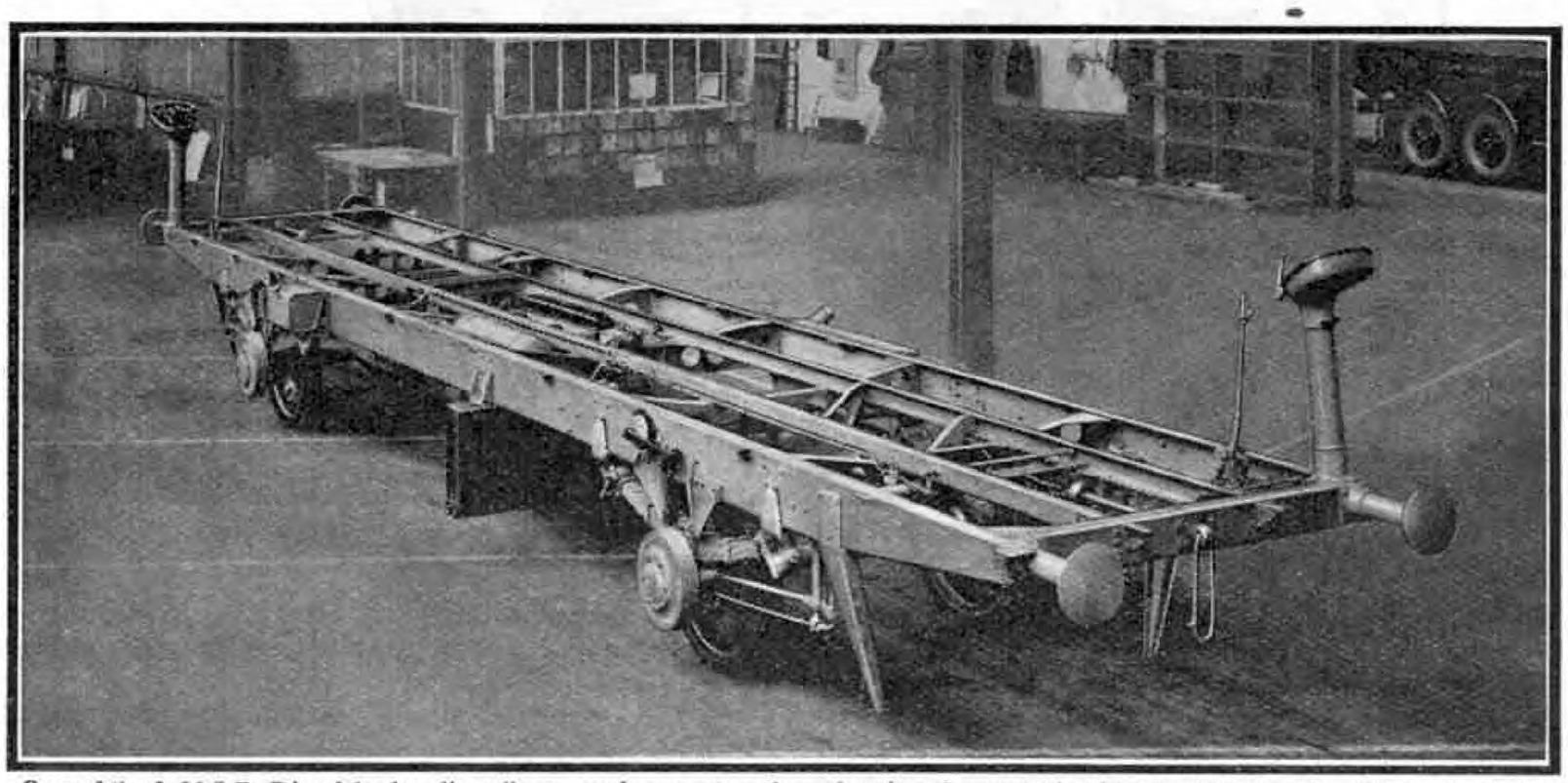
The Great Eastern Railway, or as it was then the Eastern Counties line, was, as we have seen, one of the earliest to favour the use of tank engines. After the Gooch "single-wheeler" tanks already mentioned, the next class of importance was introduced in 1864. These engines were of the 2-4-2 wheel arrangement with outside cylinders and rear tanks. They were not large engines, but were notable as being practically the earliest 2-4-2 tanks, and in addition the leading wheels were afforded some lateral motion by means of a radial truck of the "Bissel" type.

In 1884 a more modern expression of the 2-4-2 type appeared on the Great Eastern. Mr. T. W. Worsdell was in charge at Stratford, and he came from Crewe, where the 2-4-2 tank with Webb's radial axle-boxes had just come out. The new Great Eastern engines were therefore a further expression of the type, but incorporated Joy's valve gear, and had cylinders having a bore and stroke of 18 in. and 24 in. respectively. (Cont. on page 664)

Light Rail Units for the L.M.S.R.

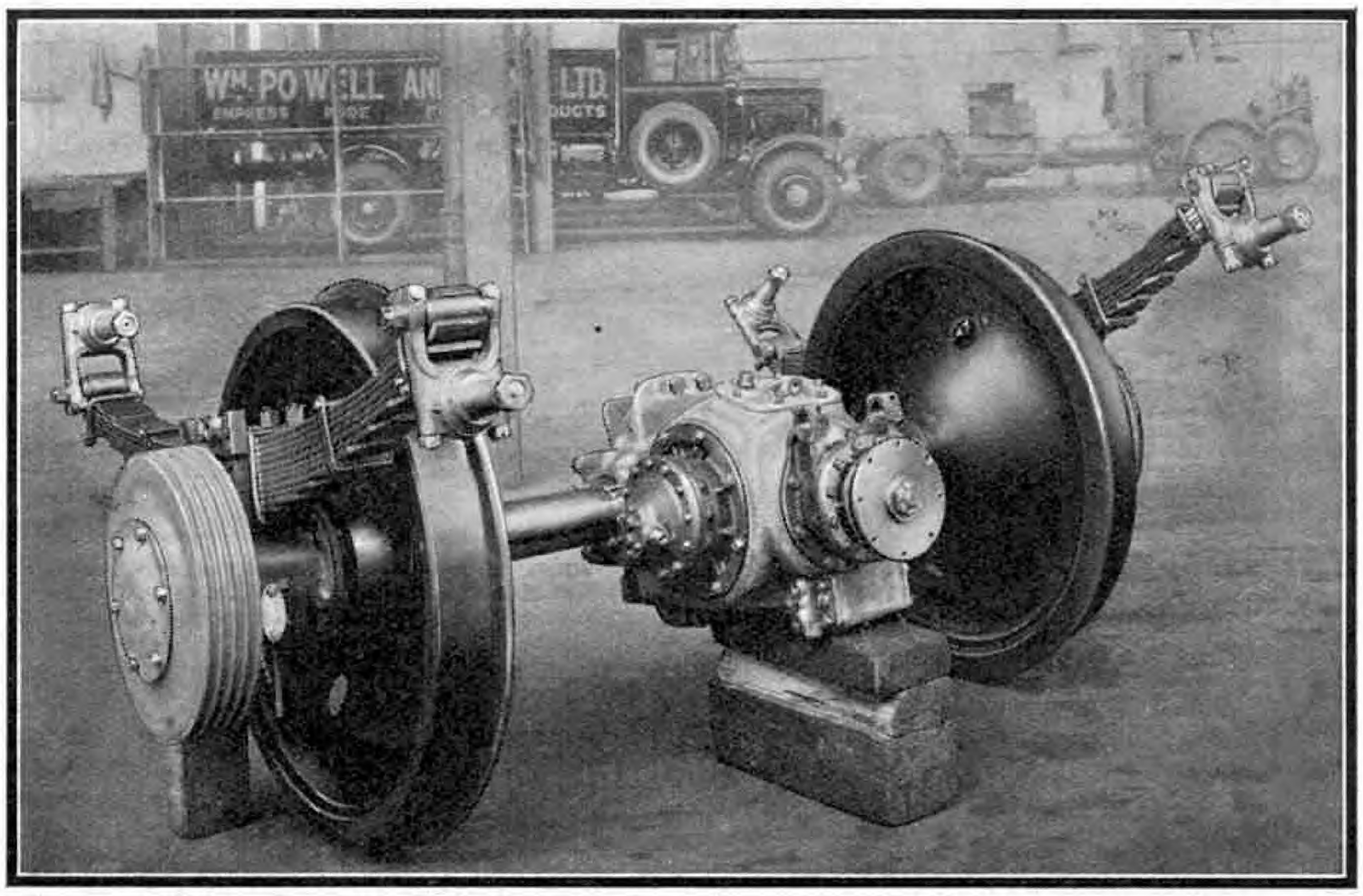
Leyland Diesel-Hydraulic Rail Cars

THE conditions of to-day in regard to railways, as compared with those of pre-War times, are having their effect in new developments that are constantly taking place. For secondary and branch line working, for instance, the branch line train of former days is far too cumbersome and uneconomical for the lighter traffic that has resulted from the extensive growth of road transport facilities. For this reason there has been a general movement on the part of the railways towards the development of light mobile units, incorporating for rail service many of the characteristics of road vehicles, and capable of satisfactory acceleration and speed, having regard to the requirements of the service for which they are intended. The L.M.S.R. have been prominent in experiments of this kind. Readers will no doubt remember the remarkable "Ro-railer" that was described in the *"M.M."* for April, 1931. This is a hybrid vehicle that can be used on road or rail as desired.



One of the L.M.S.R. Diesel-hydraulic rail cars under construction, showing the control columns at each end. We are indebted to Leyland Motors Ltd. for the illustrations to this article.

A further step has been the recent acquisition from Leyland Motors Ltd., of six light passenger units for service on secondary and branch lines. For work of this kind rapid acceleration plays a vital part in providing the necessary fast service; on the other hand a high maximum speed is, by itself, of comparatively little importance. One of the primary objects aimed at in the design of these vehicles, therefore, has been to produce cars of light weight and simple type, economical both in first cost and in maintenance, and above all with a high rate of acceleration. As the result of close co-operation between the two companies, cars have been produced that weigh only $10\frac{1}{2}$ tons, seat 40 passengers, and reach speeds of 20, 30, 40 and 50 m.p.h. in 11, 20, 32 and 49 seconds respectively. At the moment their maximum speed is governed down to 56 m.p.h., which can be maintained comfortably on gradients of normal severity.



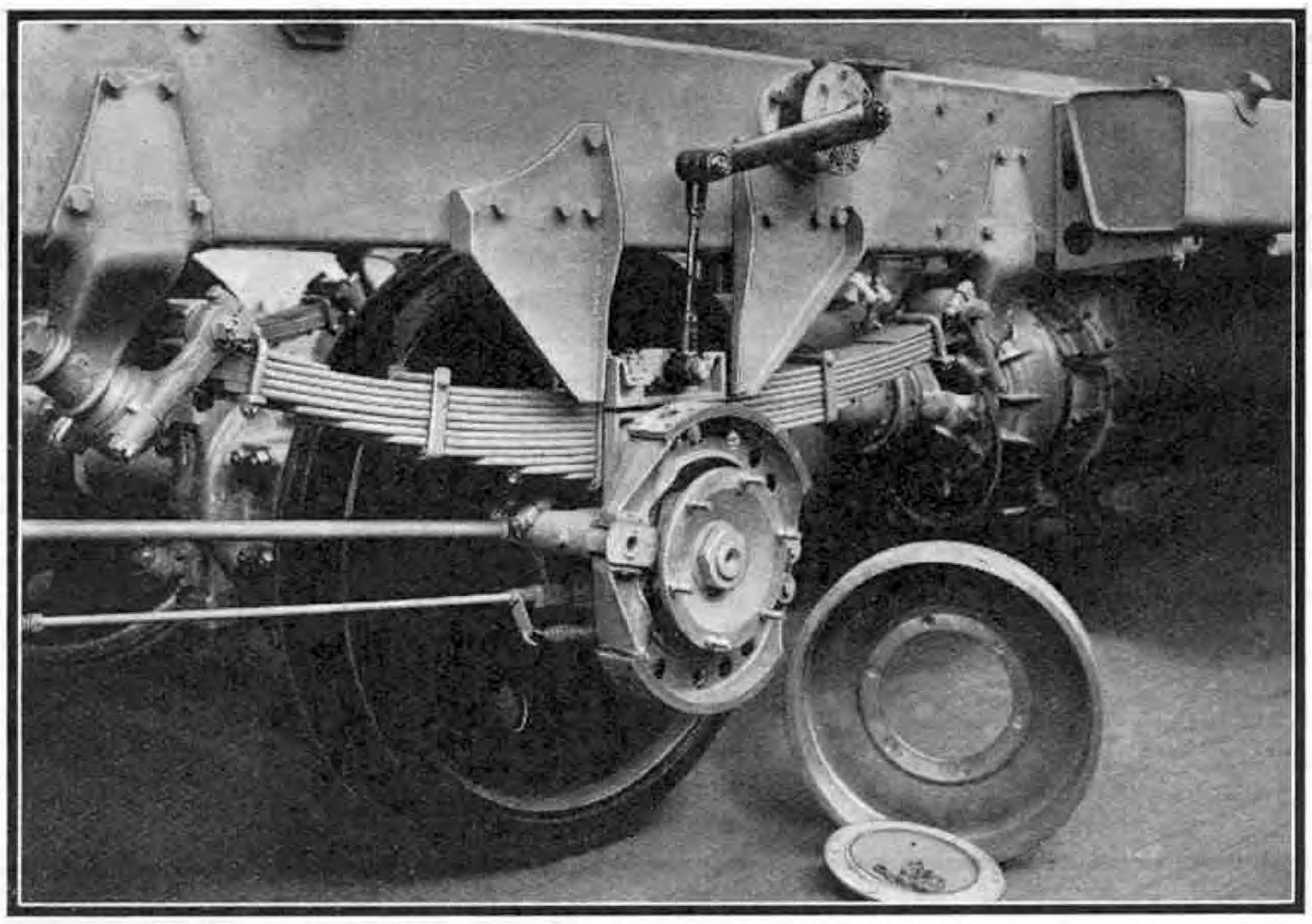
The rear or driving axle and wheels, showing the springs and one of the large diameter brake drums. This outside position of the drums renders them easily accessible and assists their cooling.

The car is of the two-axle type, one axle being driven. The power unit is a six-cylinder oil engine mounted under the floor, and transmitting its drive to the axle through the Leyland Hydraulic Torque Converter. Control is effected from either end of the car from an instrument board in each driving compartment; the controls including electro-pneumatic mechanism for the operation of the Torque Converter and reverse gears, and mechanical control of the throttle, power brake, and hand brake.

The six-cylinder compression ignition oil engine develops 130 h.p. at 2,000 r.p.m., at which speed it is governed. It is rigidly bolted at four points to the frame in the centre of the chassis. Its auxiliaries include a 24-volt starting motor, Bosch injection equipment, governor, and fuel filter, and a lubricating filter. Water circulation is effected by a pump through a vertical radiator disposed transversely across the frame toward the rear of the engine. The

circulating water can in addition be by-passed to thermostatically controlled heaters in the car.

The unusually rapid acceleration is due in part to the high power-weight ratio, but is largely attributable also to the performance of the Leyland hydraulic torque converter. This, while permitting the maximum horsepower of the engine to be applied during the whole of the period of acceleration, produces an unusually rapid, silent and smooth get-away, unbroken by any gear changes. The torque converter consists essentially of a centrifugal pump mounted in a single casing with a three-stage hydraulic turbine. The pump member is similar in form to the impeller of the familiar water-circulating pump. The turbine, which is connected to the driving axle through a free-wheel, consists of a bladed rotor on which three separate rows of blades are fixed in such a position that they are divided by two rings of stationary blades fixed to the casing.



An interesting close-up view of the suspension and brake gear. The outside brake drum has been removed, thus exposing the fabric-lined brake shoes.

The casing is completely filled with fluid, so that when power from the engine is transmitted to the pump the fluid is driven from the pump on to the first set of rotor blades, and then through stationary blades where its flow is re-directed on to the second set of rotating blades. From here it passes through further stationary blades where its direction is again changed; on to the third set of moving blades, and so back to the pump. Owing to the shape of the blading, and the fact that the fluid impinges on three sets of blades coupled in series, torque can be increased up to the ratio of 4.8 to 1.

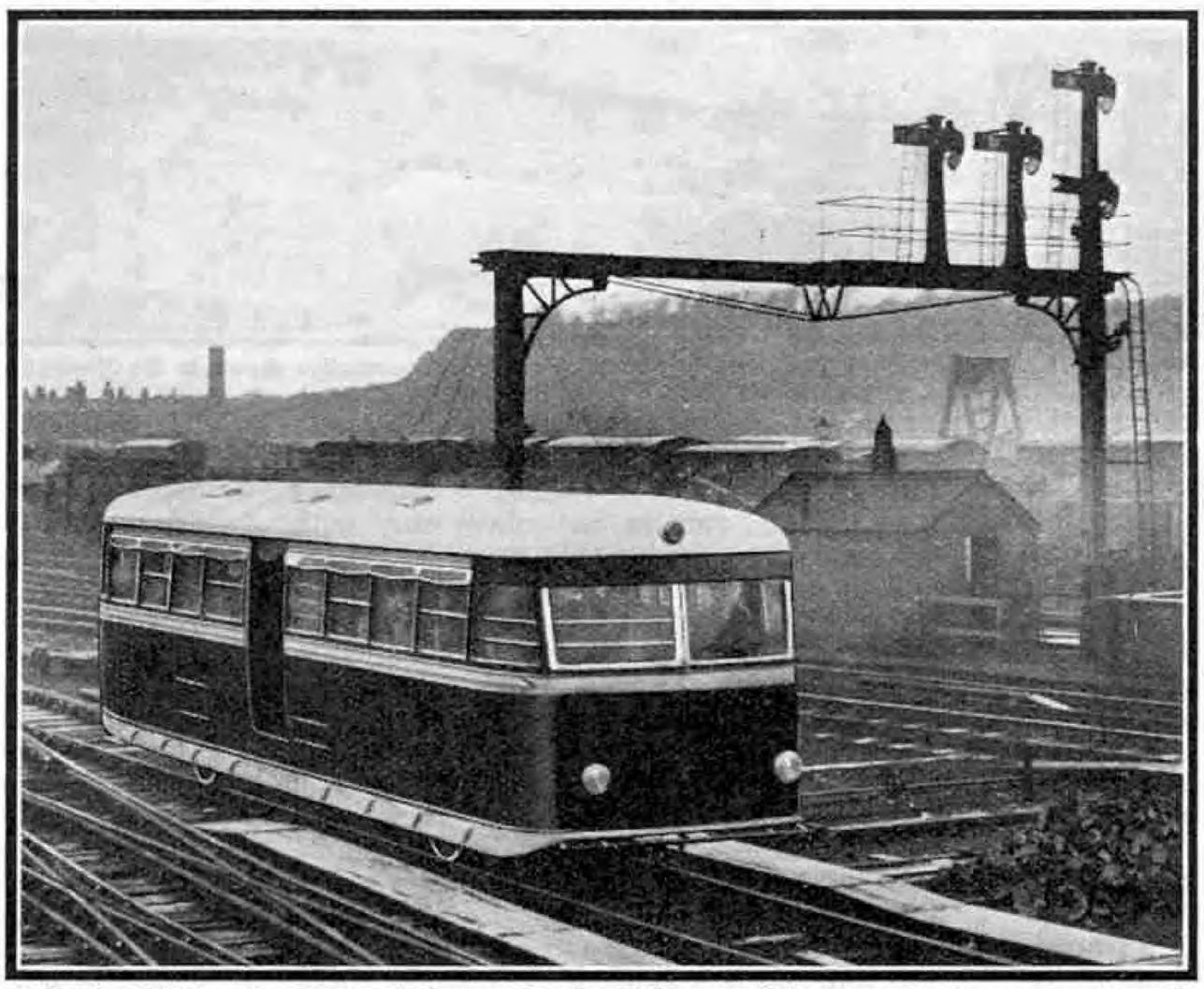
In order to limit the temperature rise in the working fluid under extreme conditions of operation, a small cooler is placed on the frame side and connected in parallel with the fluid circulation. In this circulation is also a by-pass filter. The fluid used in the converter consists of a mixture of paraffin and 5 per cent. of light spindle oil or of ordinary fuel oil as used for compression ignition engines.

A free-wheel is provided on the shaft driven by the turbine rotor. Thus the converter is completely isolated and comes to rest immediately its clutch is disengaged, so permitting a direct drive in which there is no hydraulic loss. Also, it makes coasting possible when the converter drive is engaged.

The axles are fitted with light cast-steel wheels having a diameter of 3 ft. over the tread. They are carried in roller bearings in the axle boxes.

The braking system is on all four wheels and can be applied by either power or hand. Unlike the usual railway type of shoe brake, which is responsible for a certain amount of tyre wear, internal expanding fabric-lined shoes are adopted, operating in four drums 17 in. in diameter located on the axle ends outside each wheel. Here they are readily accessible, and are well cooled by the movement of the car.

A considerable weight reduction is shown by the suspension adopted as compared with the usual railway form of construction. Semi-elliptic springs are used, a feature of which is the anchorage at each end. This can perhaps be best described as a swinging link, universally jointed at one end, and free to move longitudinally at the other. This arrangement allows the axle to follow the curve of the rail, and at the same time permits of a restrained lateral movement to cushion any shock received at the wheel flange when passing over points. Brackets are also fitted that limit the fore and aft movement of the axle, but do not normally take part in its constraint.



A Leyland light rail unit on a test run. During trials one of these cars made an average speed of 54.4 m.p.h. up the severe climb to Shap summit.

The controls, with the exception of the hand brake lever, are mounted in a compact group on a control column, one of which is installed in a separate compartment at each end of the car. All controls are interconnected, and so simple is their operation that it has been found possible for a driver to take over control of the car after only 15 minutes' tuition in the details of its operation.



Speeding Up Continental Trains

Some noteworthy accelerations have been made this summer in the railway services on the Continent of Europe. Although many countries share in these, the chief honours go to Germany where improvements of a phenomenal nature have been introduced. The new German time-tables contain no less than 26 runs, having a total mileage of 3,043 miles, at over 60 m.p.h., while there are many more runs at little under that speed. How revolutionary are these changes will be realised when it is recalled that but three years ago the fastest run in Germany was one of only 30 miles at 58 m.p.h. The fastest run to-day is that of the *"Flying Hamburger"* railcar from Berlin to Hamburg at 77.4 m.p.h. The quickest steam-hauled run is between the same cities at 69.4 m.p.h. Another very smart run is that of the Hook of Holland boat express, which covers the 157.8 miles from Hanover to Berlin in 148 min., requiring an average speed of 65.8 m.p.h.

Of other Continental accelerations, probably the most notable is that of the famous *"Sud Express"* which since 15th May last has been scheduled to do the 362.0 miles from Paris to Bordeaux in 355 min. including stops, so making it the fastest train in the world for a distance of over 350 miles. In the earlier stages the train is electrically hauled and averages over 60 m.p.h. Later, steam takes the place of electricity and is responsible for a brilliant burst of speed in which the 70 miles from Poitiers to Angoulême are run off in exactly an hour, start to stop. This run ranks second only to the G.W.R. *"Cheltenham Flyer"* as a record for a steam-hauled train in regular working. The journey of the *"Sud Express"* ends at Lisbon and the train has been speeded up in Portugal, the last 70 m. being run in 74 min., giving an average speed of 56.8 m.p.h.

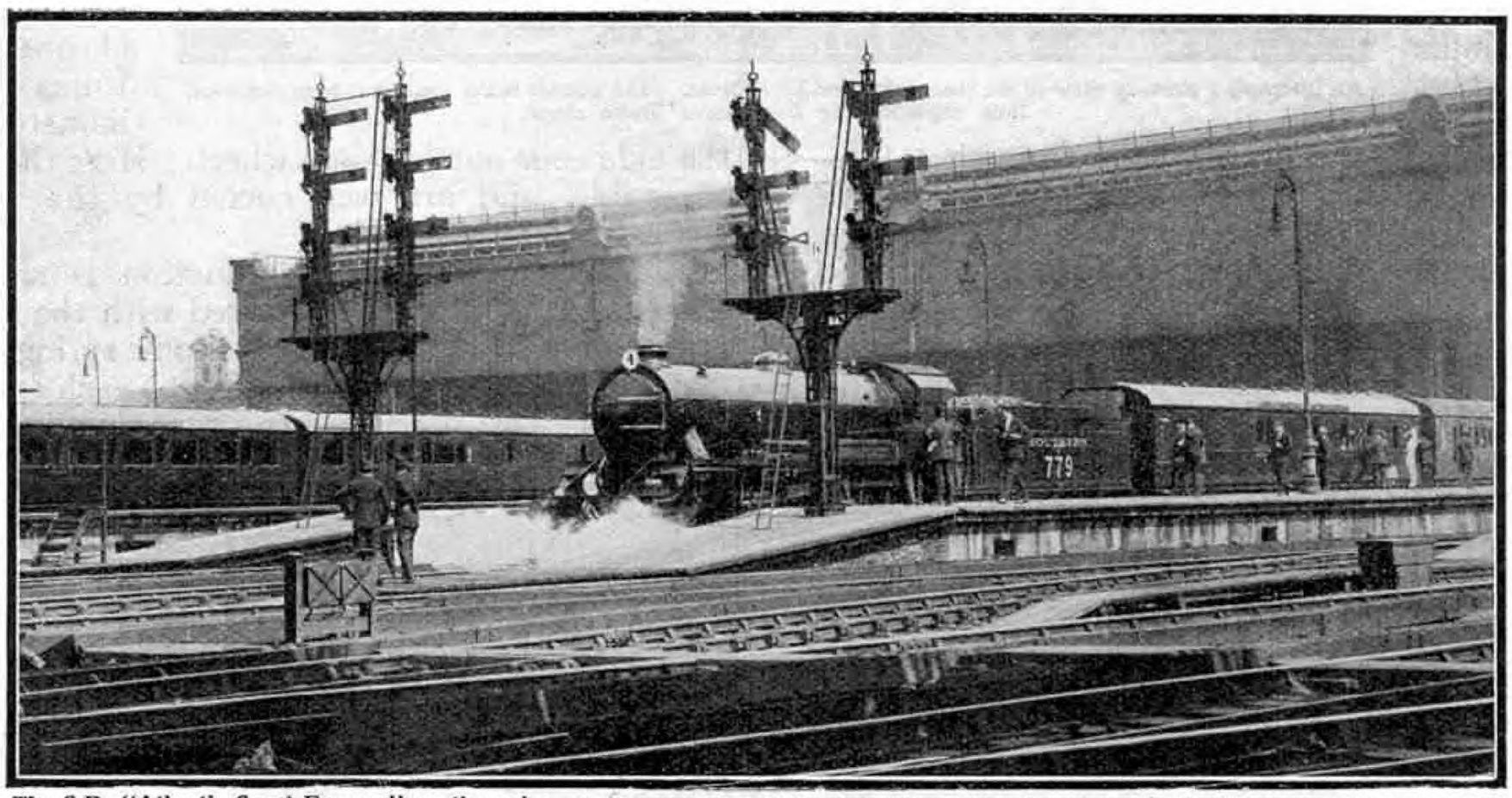
Holiday Train Services

Some further particulars of the special summer services on British railways can now be added to those given in last month's *"M.M."* The L.M.S.R. time-table that came into force on 9th July shows 896 new services and 290 accelerated trains. The innovations include a new fleet of trains, known as "Rapids," between important business and holiday centres. Each of these carries a nameboard with the destination and the word "Rapid" printed in black letters on a yellow ground. All the "Rapid" trains, such as the *"Glasgow and Edinburgh Rapid," "Llandudno Rapid," "Blackpool Rapid,"* etc., run on Saturdays only with the exception of three that leave on Friday nights. In this connection it may be mentioned that the great increase in week-end travel has made it necessary for the railways to print the principal Saturday services on separate pages in the time-tables.

On the L.M.S.R. a new named train has appeared. This is *"The Fylde Coast Express,"* which gives the fastest-on-record service from Blackpool to London. Leaving Blackpool (Central) at 8-25 a.m. it reaches Euston in 4 hrs. 27 mins., the run of 158 miles from Crewe to Euston being made in 156 min., at a start-to-stop average speed of 60.7 m.p.h.

A striking feature of the holiday services is the large number of lengthy non-stop runs made by L.M.S.R. trains, especially at week-ends. *"The Royal Scot"* again runs non-stop in each direction between Euston and Carlisle, a distance of approximately 300 miles. Other specially long runs are: Crewe to Perth, 291¾ miles; Euston to Penrith, 281¼ miles; Euston to Holyhead, 263¾ miles; Glasgow to Crewe, 243½ miles; Euston to Preston, 209 miles; and Euston to Prestatyn, 205¾ miles.

The very extensive accelerations and additional services instituted by the S.R. last summer, and which have been permanently incorporated in the time-table, have made it almost impossible for that Company to make further cuts in journey times this year. Many additional expresses are running, however, particularly at the week-ends and to the more distant resorts, and marked accelerations have been effected in the services between Waterloo and Weymouth, most of the expresses having had their times cut by 10 min. or more. The 4.30 p.m. down express now reaches Weymouth in three hours.



The S.R. "Atlantic Coast Express" on the point of departure from Waterloo. The locomotive shown in the illustration is No. 779 "Sir Colgrevance," of the 4-6-0 "King Arthur" class.

The popular all-Pullman train, the *"Bournemouth Belle,"* is again running daily. The *"Atlantic Coast Express"* now leaves Waterloo at 10.35 a.m. for North Devon and North Cornwall, but passengers for Exeter and Plymouth leave as hitherto at 11.0 a.m. Portsmouth and the Isle of Wight are given a very generous service and on Saturdays a half-hourly service of non-stop trains is provided between Waterloo and Portsmouth. So heavy is the traffic between Portsmouth and Ryde that seven steamers are required to maintain the service. A new paddle steamer, named *"Sandown,"* has just been built and put into this service.

G.W.R. Locomotive News

The programme of new construction outlined on page 469 of the *"M.M."* for June last is being carried out according to plan and most of the small tank engines there mentioned have already been completed at Swindon. Work is now being pushed forward on the new lot, 10 in number, of 0-6-0 tender engines of the "2251" class

and it is expected that these will be finished by the end of this month. Special attention is being given at present to repairs and every big passenger engine that comes in is turned out again as quickly as possible in order to help with the heavy Summer traffic. The 10 new engines of the "Castle" class are by this time nicely "run in" and able to take a full share in fast express working.

Another 4-4-0 engine of the "Bulldog" class, No. 3337, *"The Wolf,"* has been taken out of service.

Trial Runs of *"Cock o' the North"*

Before being put into regular work on the Scottish services between Edinburgh and Aberdeen, the new L.N.E.R. 2-8-2 locomotive, *"Cock o' the North,"* has been undergoing very thorough trials in the Southern area, being stationed the while at Doncaster. It has been a frequent visitor to King's Cross and has worked a number of fast expresses with the dynamometer car added and with the load augmented to about 600 tons. An article giving an account of a splendid run made by the engine during these trials appears on page 619 of this issue of the *"M.M."*

It has been noted as an interesting coincidence that 2001, the number borne by *"Cock o' the North,"* which is the first British eight-coupled express locomotive, also was the number carried by the first British six-coupled express locomotive which was built by Mr. Wilson Worsdell for the North Eastern Railway in 1899.

First "Baby Scots" with Tapered Boilers

The first lot of five improved 4-6-0 "Baby Scot" locomotives with tapered boilers have been turned out from the works at Crewe. Their numbers are 5552 to 5556 and the first is stationed at Camden shed. Many of the new engines as they are completed will be allocated to the Midland division. Of the preceding series with parallel boilers, the first five, Nos. 5542-6, are shedded at Kentish Town and the other five, Nos. 5547-51, at Preston.

Among the latest withdrawals are two more L.N.W.R. 4-6-0 "Experiments," No. 5461, *"City of London,"* and No. 5526, *"Bactria"*; and three 4-6-0 "Claughtons," No. 5931, *"Captain Fryatt,"* No. 5945, *"Ingestre,"* and No. 6009 (not named).

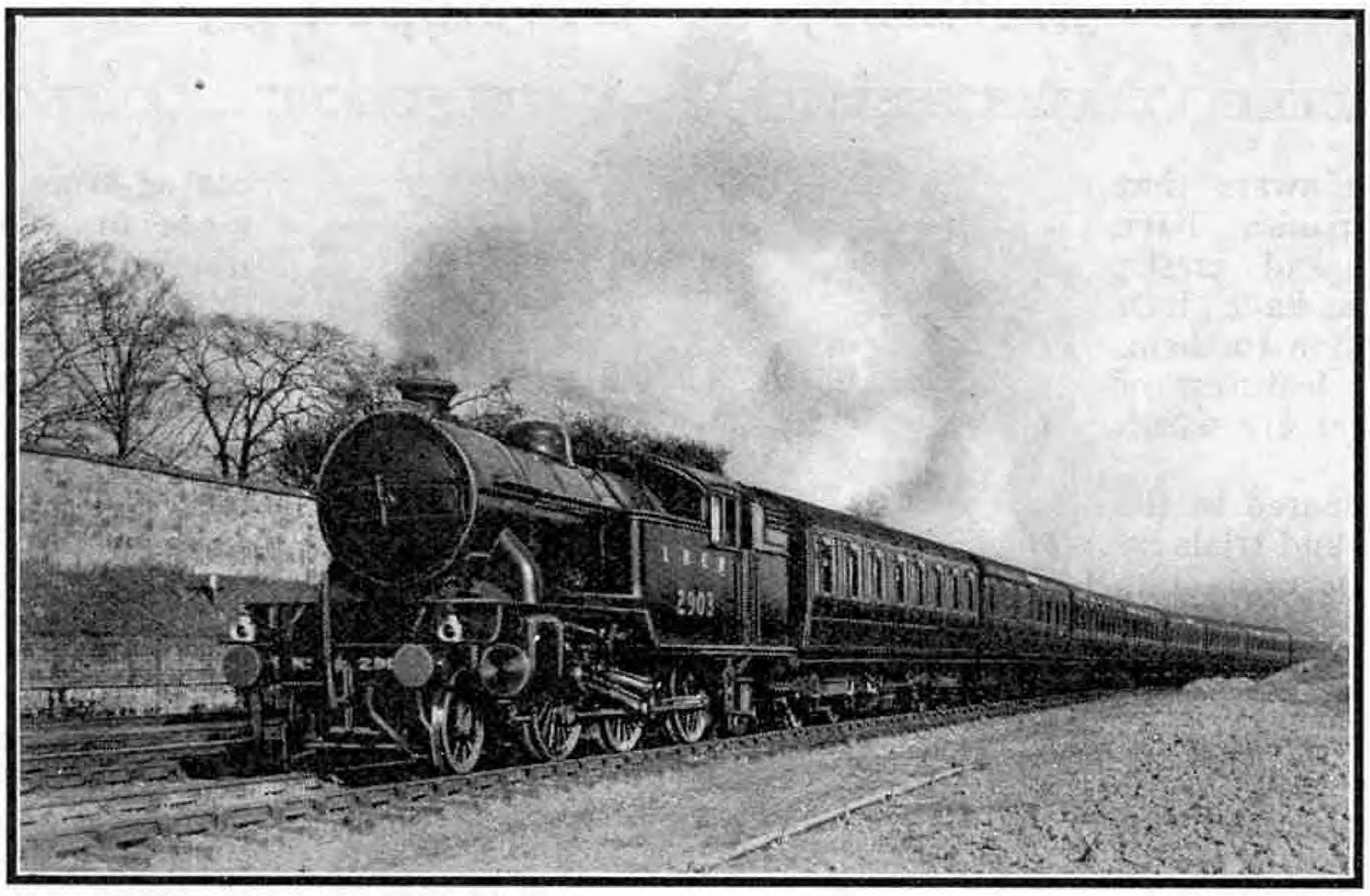
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The L.M.S.R. are to instal larger locomotive turntables at six important traffic centres. Three of these, at Liverpool, Manchester and Derby respectively, will be of 70 ft. diameter, and others at Stoke, Burton and Gloucester will vary from 55 ft. to 60 ft. across.

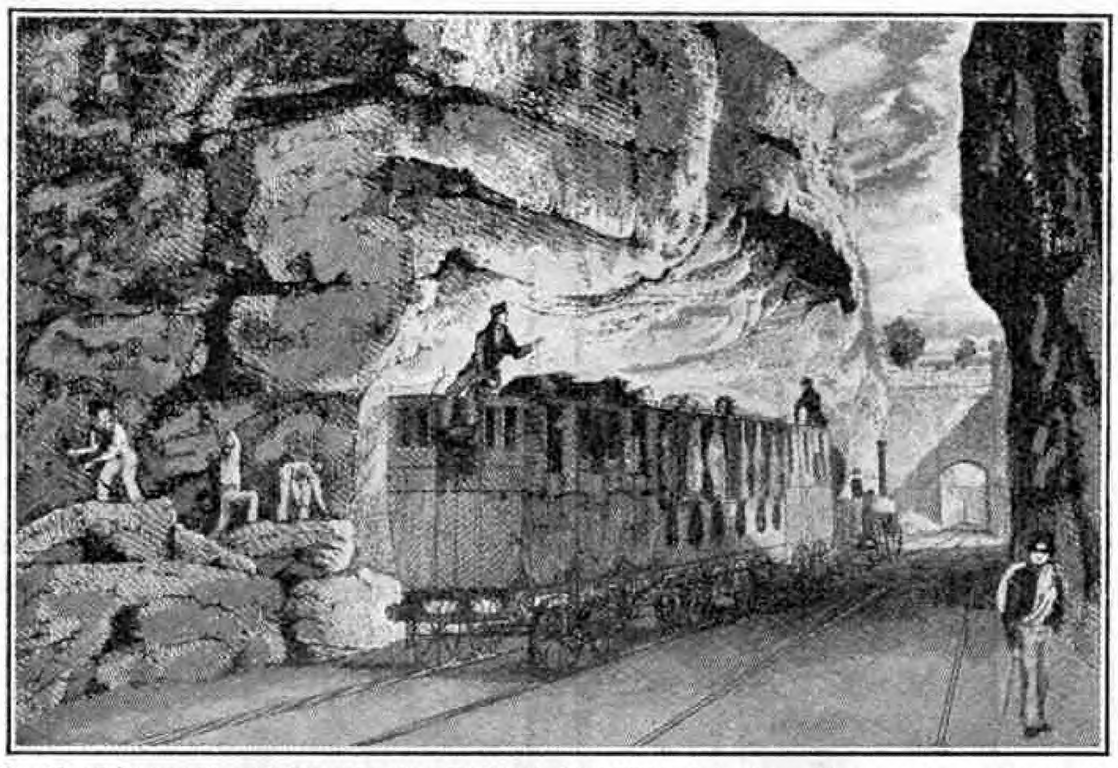
G.W.R. Heavy Oil Express

Streamlined expresses, driven by heavy oil engines, made their first appearance in this country on the 9th of July when the G.W.R. introduced an experimental super rail car service on the Birmingham, Gloucester, Newport and Cardiff route.

Three cars have been specially built for this purpose. They cover the distance of 117½ miles at an average speed of 56½ m.p.h. including stops at Gloucester and Newport. There is one class only, but passengers are charged 2/6 each journey over and above the third class single or Summer Ticket fare.



An L.N.E.R. train from Glasgow to Helensburgh near Jordanhill. The locomotive, No. 2903 of the three-cylinder 2-6-2 tank class, is carrying the curved destination board characteristic of the N.B. Section of the L.N.E.R. Photograph by Mr. J. M. Craig, Glasgow.



On the Liverpool and Manchester Railway in 1831! A train with guards on the roofs of the carriages passing through Olive Mount cutting, which has since been widened. This famous cutting is not far from the factory of Meccano Ltd.

The new cars are similar in external appearance and design to the experimental rail car that has been providing local services in the Southall, Reading and Oxford district during the last five months, in which time it has covered over 22,000 miles and carried 50,000 passengers.

The results of the Company's experiment will be watched with great interest, for the introduction of these cars may well prove to be the beginning of a new era in rail transport.

Numbers for Famous G.W.R. Trains

A system of numbering long distance expresses on Saturdays so that each can be identified immediately at any point en route by signalmen or station staff, so as to ensure more expeditious handling, has been brought into use by the Great Western Railway. The new system makes it possible, at a glance, to tell the starting time and place of the train, its destination and also whether it is running in two, three, four or five parts. Such expresses are facilitated and given the "through" roads, while this recognition enables the station staff to deal more speedily with a train on its arrival.

The system of numbering is by means of black and white figures 1 ft. 4 in. in height, carried in a slotted frame 3 ft. long on the front of the engine. Owing to the better sighting it provides, a three-figured number has been allocated to each train, and this makes identification easy at a distance of over a quarter of a mile.

The left-hand figure of the number provides the "key" to the starting place, and the other two numbers identify the train itself. All expresses from Paddington bear the numbers 100-199, from Shrewsbury 200-299, from Wolverhampton and Birmingham 300-399, from Bristol 400-499, from Exeter 500-599, from Plymouth 600-699 and South Wales 700-799.

The number of each train ends in "0" or "5," the intervening numbers, 1, 2, 3, 4 and 6, 7, 8 and 9, being reserved for use in the event of the train being run in more than one part. For example, the world famous *"Cornish Riviera Express"* from Paddington is known to every signalman, porter and inspector as "Train Number 125," and any division of this train bears the numbers 126 to 129 inclusive. The Up *"Riviera"* is "Train Number 615."

It is expected that the introduction of this new system will greatly assist in the working of "through" expresses to the increasingly popular West country area, especially at busy junctions in and around Taunton, Exeter and Newton Abbot districts, where traffic from London, Wales, the Midlands, the North and Scotland pours through in a continual stream.

Steel Keys for the Iron Road

For some time past the G.W.R. have been experimenting with various designs of steel keys for the permanent way and as a result now propose to purchase 100,000 steel keys. As some of these will be used in conjunction with steel sleepers, the combination will provide a permanent way completely composed of steel and cast-iron.

British Railway Coats-of-Arms

How Heraldry Developed

MOST of us are aware that railway companies have coats-of-arms and crests, but probably few of us have given any particular attention to them. They have many features of interest, however, and are worth a little careful study.

Coats-of-arms originated in the days of tournaments and trials by combat, when knights wore suits of armour that completely covered them. There was thus a great general similarity in their outward appearance, and they could be recognised only by the devices emblazoned on their shields and surcoats. In battle, armorial bearings were of even greater importance, for it was only by means of them that the leaders could be recognised. It is said that the loss of the battle of Barnet in 1471, in which Edward of York beat the Lancastrians under the Earl of Warwick, was partly due to the similarity between two coats-of-arms. The Earl of Warwick, mistaking the emblem of John de Vere, a star with streamers, for the royal emblem of a sun, charged the former instead of the king.



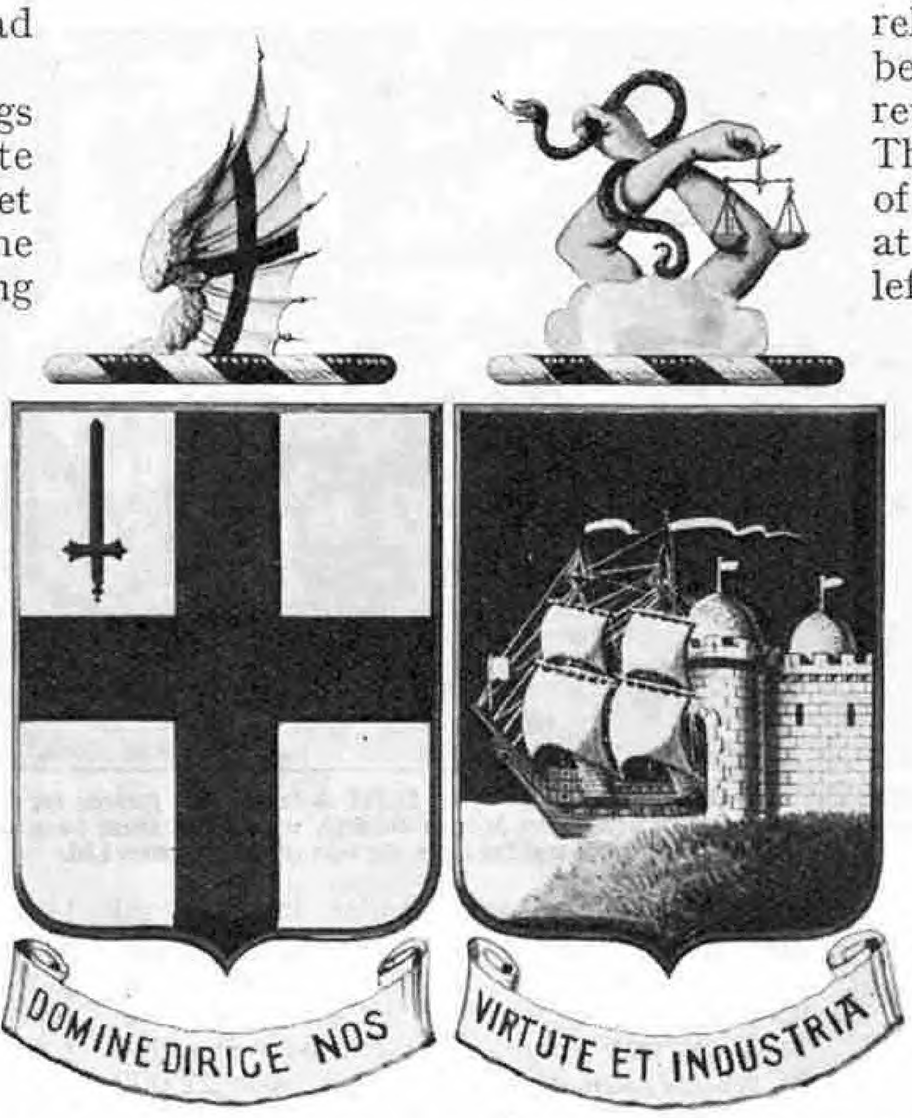
The illustration above shows the coat-of-arms of the London and North Eastern Railway, by whose courtesy it is reproduced here. Below is the coat-of-arms of the Great Western Railway Company, which is an amalgamation of the coats-of-arms of London, on the left, and Bristol, on the right. Photo courtesy G.W.R.

The regulation of armorial bearings was carried out by an officer of state known as a herald, and thus we get the name heraldry applied to the science of "blazoning" or describing coats-of-arms. The word blazon is the same as the German "blasen," meaning to blow as with a horn, because it was customary on public occasions to proclaim in this manner the style and arms of each knight. French was the language in use among the nobles and the upper classes generally at that time when the science of heraldry began to develop, and consequently most of its terms are French, or of French origin.

The science of heraldry is highly technical and complicated, but fortunately it is only necessary to know a few of its elementary principles in order to appreciate the main features of railway coats-of-arms.

The foundation of heraldry is the shield. The surface of this is called the field, and whatever is carried upon it is the charge; field and charge together forming the coat-of-arms. Many colours are used in coats-of-arms, among which may be mentioned "azure" (blue); "gules" (red); "sable" (black) and "vert" (green). There are also the metals "or" (gold) and "argent" (silver); and various furs. The different colours contrast strongly with one another, and also with the metals; and in order that this contrast should not be weakened it was the rule that metal should not be placed upon metal, or colour upon colour. It is interesting to note that in *"Ivanhoe"* Scott describes the black knight as bearing "a fetter lock and shakle bolt azure on a field sable," which breaks this rule. When challenged in regard to this description, Scott quoted in defence the arms of the kingdom of Jerusalem, "argent, a cross potent between four crosses, all or," which similarly breaks the rule.

The right-hand side of the shield is known as the "dexter" side, and the left-hand side as the "sinister" side. It is important to remember that these terms relate to the point of view of the bearer of the shield, so that they are reversed as regards the spectator. Thus the dexter or right-hand side of the shield is on the left as looked at by the observer, and the sinister or left-hand side is on the right.



The charges on shields are very varied, but may be divided roughly into animate and inanimate objects. Taking the animate class first, we find a collection of remarkable fabled monsters. There is the griffin, half eagle and half lion, and supposed to represent wisdom and strength. The dragon is a winged monster with the head of a griffin, four legs, barbed tongue and tail, and immense claws. The wyvern is a two-legged version of the dragon, and the cockatrice is a wyvern with the head of a cock. There is also the unicorn, with the body of a horse and a long horn springing from the forehead, which is familiar to most of us in the Royal armorial bearings. Man is represented whole in the form of saints, or in fragments such as the eye, the arm and the leg—the last name immediately calling to mind the arms

of the Isle of Man. Lions play an important part, and among birds the eagle is prominent. The inanimate charges consist mainly of astronomical representations, mountains, rocks, rivers and trees; and such artificial matters as castles, crowns, swords, spears, ships and anchors.

The lion appears in heraldry in a variety of positions. Among these may be mentioned "couchant," lying down with head raised; "statant," standing with all feet on the ground; "rampant," erect on hind legs; "passant," walking, looking ahead; and "passant guardant," walking, looking towards the observer.

In the days before grouping, practically every one of the large number of railway companies had its own coat-of-arms. Of these the Great Western coat-of-arms alone remains unchanged, the others having disappeared as the companies were absorbed into the four groups. The London Midland and Scottish and the London and North Eastern railways have developed coats-of-arms, but so far the Southern Railway has not done so, although it undoubtedly will in the near future.



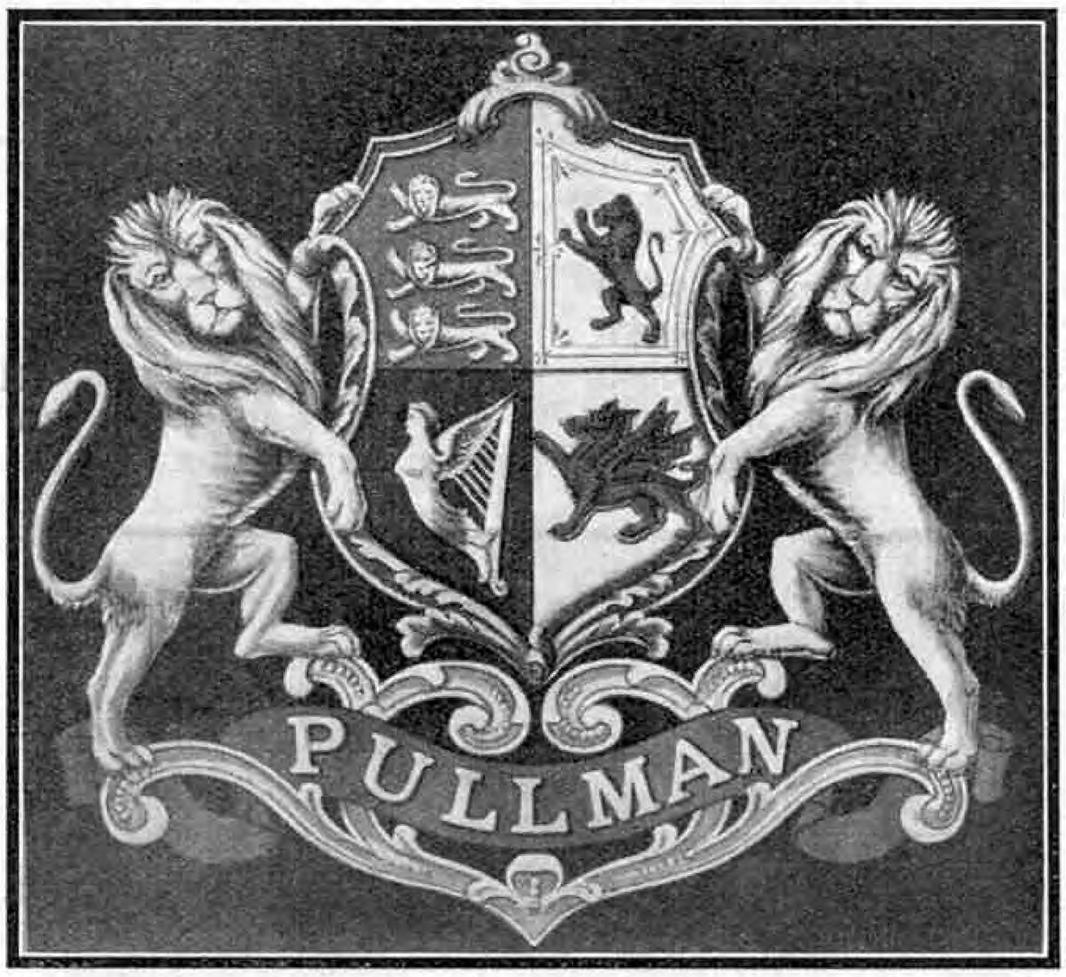
The emblem of the London Midland and Scottish Railway, which includes the English rose and the Scottish thistle. Photograph by courtesy of the L.M.S.R.

The coat-of-arms of the Great Western Railway Company was adopted in 1835 by Mr. Benjamin Shaw, the first chairman of the company. It is an amalgamation of the coats-of-arms of London and Bristol. This selection was made on account of the fact that in the Great Western Railway Act of 1835 the extreme limits of the railway were defined as between London and Bristol. The mottoes of both cities have been adopted.

The coat-of-arms of the City of London consists of a shield charged with the Cross of St. George, the patron saint of England, dividing it into four parts. Point upward in the dexter or honorary quarter is the Roman sword of St. Paul, the patron saint of London since the seventh century. This part of the city arms dates from about the year 1280. Some writers have stated that the sword represented the dagger with which Lord Mayor Walworth slew Wat Tyler, but this is disproved by the fact that the sword figured in the city arms before Wat Tyler met his death. The shield in the original arms is supported on each side by dragons with outstretched wings charged with a cross. These dragons, and the motto "*Domine Dirige Nos*" (Lord Direct Us), were added in the 17th century. In the Great Western arms a wing of a dragon charged with a cross is used as the crest, the remainder being dispensed with.

The arms of the city of Bristol consist of a shield emblazoned with a castle on a mound, with two domed towers each flying a banner charged with the Cross of St. George. The castle recalls the historic fortress on the River Avon founded by King Alfred in the year 887; and the three-masted ship signifies the city's maritime importance. The position of the castle was such that it commanded the entrance to the city. It had a secret port through which vessels passed, and the archway through which the ship is shown sailing represents the secret harbour. The crest shows two arms issuing from a cloud; one hand holding a snake, signifying wisdom, and the other a pair of scales, signifying right judgment. In the city of Bristol arms kneeling unicorns support the shield on each side, to render homage to the city and its virtues; but in the Great Western arms the unicorns have been omitted. The motto is "*Virtute et Industria*," meaning "By Virtue and Industry."

The coat-of-arms of the London and North Eastern Railway appears to be built up upon the shield of York, the city that forms the hub of the system. York has five lions "passant guardant," but in the L.N.E.R. shield the centre lion is replaced by what is presumably a representation of Edinburgh Castle. The empty quarters are filled by the English rose, the Scottish thistle, and two fearsome black griffins, which may be taken to represent London. The supporters bear the emblems of England and Scotland, but the Scottish unicorn has become a lion. The crest shows Mercury springing out of a cloud of steam. The suitability of his selection lies in the fact that, by the aid of his winged hat and winged sandals, he was able to pass with the utmost speed to any part of the universe. The motto, "Forward," is the slogan of the old Great Central Company.



The striking coat-of-arms of the Pullman Car Company Ltd. The four quarters of the shield represent England, Scotland, Ireland and Wales respectively. Photograph by courtesy of the Pullman Car Co. Ltd.

As has already been stated, the Southern Railway at present has no coat-of-arms, which is a pity. This company has ample material at its disposal for the designing of a splendid coat-of-arms from those of the companies of which it is composed. The London and South Western Railway coat-of-arms is interesting in having five quarterings, representing respectively the City of London, Southampton,

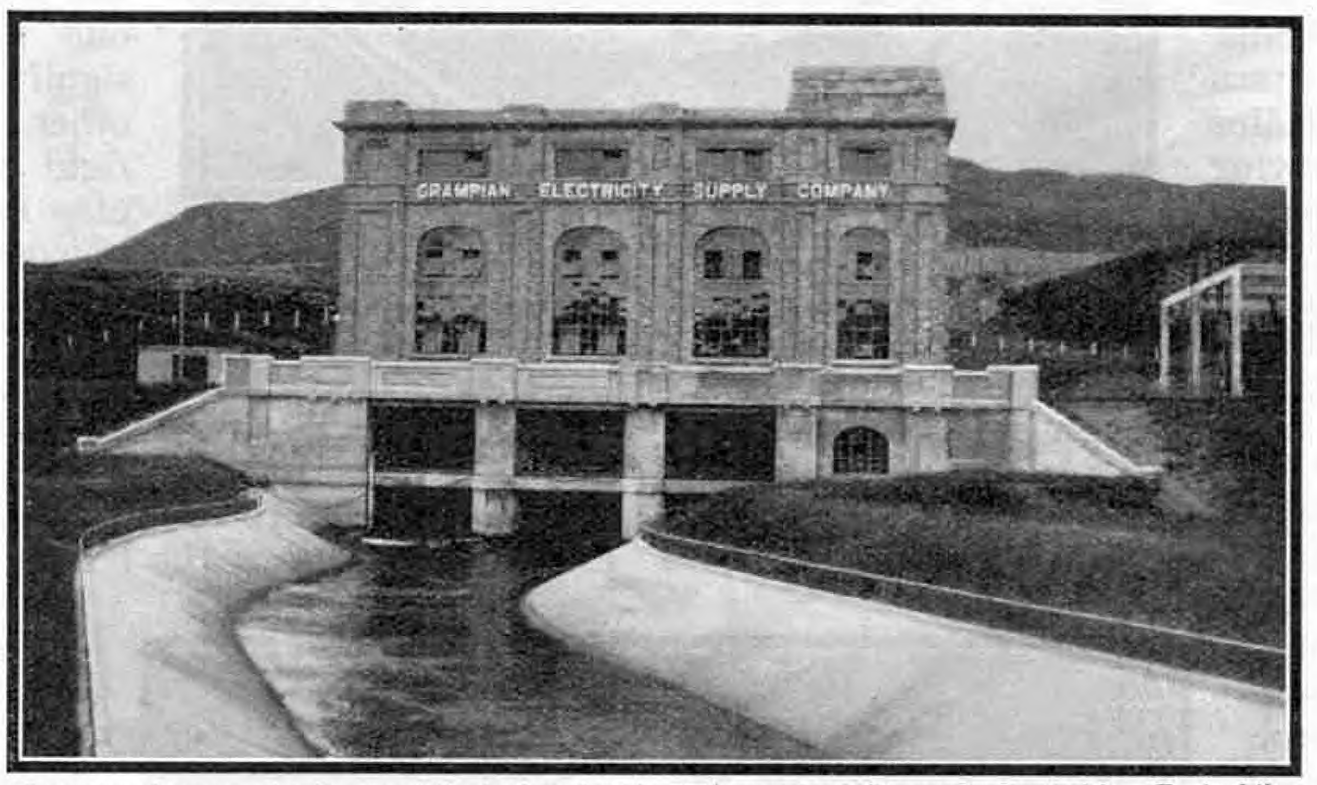
(*Continued on page 664*)



These pages are reserved for articles from our readers. Contributions not exceeding 500 words in length are invited on any subject of general interest. These should be written neatly on one side of the paper only, and they may be accompanied by photographs or sketches for use as illustrations. Articles that are published will be paid for at our usual rates. Statements contained in articles submitted for these pages are accepted as being sent in good faith, but the Editor takes no responsibility for their accuracy.

The Hydro-Electric Power Station at Loch Rannoch

Several of the new power stations erected in Scotland in connection with the Grid Scheme are of the hydro-electric type, and one of the most interesting of these is that at Loch Rannoch, Perthshire, which is shown in the accompanying illustration. It is equipped with two turbo-alternators, each driven by a water turbine of the reaction type, but only one actually is in use at a time, the other then being overhauled.



The power house and tail race of the hydro-electric station at Loch Rannoch, Perthshire. Part of the outdoor transformer station is shown on the right. Photograph by I. S. Wickenden, Rocester, Staffs.

The alternators are coupled direct to the turbines, each of which is of 22,000 h.p. and drives its alternator at the speed of 500 r.p.m. The water reaches the turbines through two pipes from the valve-house on the hill behind the station. It comes from Loch Ericht, which lies to the north of Loch Rannoch and is much higher. The River Ericht has been dammed about a mile below the loch, which has been lengthened by this amount and also raised several feet, thus enormously increasing its capacity. Water is taken to the valve-house immediately above the generating station through a pipe driven under the hills, and it has practically caused the disappearance of the River Ericht, which now flows only when the level of water in the loch is abnormally high. The total head of water from the dam to the turbines is 465 ft.

The current generated by the alternators is at a pressure of 11,000 volts, which is too low for transmission over long distances; and therefore it is stepped up by means of outdoor transformers to the Grid standard pressure of 132,000 volts. Some of the current is intended for local distribution, however, and this is stepped up to only 66,000 volts. The whole system of generators and alternators is thoroughly protected from lightning by means of spark gaps and automatic circuit breakers situated outside. The control boards and offices are on the first floor, and the station is fitted with a " wired wireless " installation that maintains communication with the dam at Loch Ericht and with a 50-ton travelling gantry crane over the alternators.

I. S. WICKENDEN
(Rocester).

A Famous British Long Barrow

During my holidays I decided to make an excursion with a friend to Belas Knap, a well-known ancient burial place. Climbing up from Cheltenham, on the outskirts of which are the Seven Springs from which the Thames is thought by many people to commence its journey to the sea, we soon found ourselves on stretches of rolling uplands. From our ordnance map we found that Belas Knap was near Wantley Farm, and after a mid-day rest in Puckham Woods we made our way north to the farm, which lay baking in the hot sunshine. Very little water remained in its well, and the pond from which the cattle drink had dried up.



The long barrow of Belas Knap, an ancient British burial place. Photograph by N. Allsworth, Cheltenham.

As we had anticipated, we obtained our first glimpse of our objective when we reached the farm. The name " Belas Knap" means " bee's mound," and the place itself is just above a wood known as "Humble-bee Wood." It is what is known as a long barrow from its shape, and consists of a huge mound enclosed in walls about 5 ft. high of tile-like slabs of Cotswold stone. In the heart of the mound 38 people were once buried, all being of the same race except one, who may have been a captive.

Belas Knap and other long barrows are thought to be from 4,000 to 5,000 years old, and were built during the Stone Age. Round barrows also are numerous in this

neighbourhood, but they are not so old, for their contents show them to have been built by the men of the Bronze Age, who cremated their dead. Belas Knap is now protected and cared for by the Government as an historical monument.

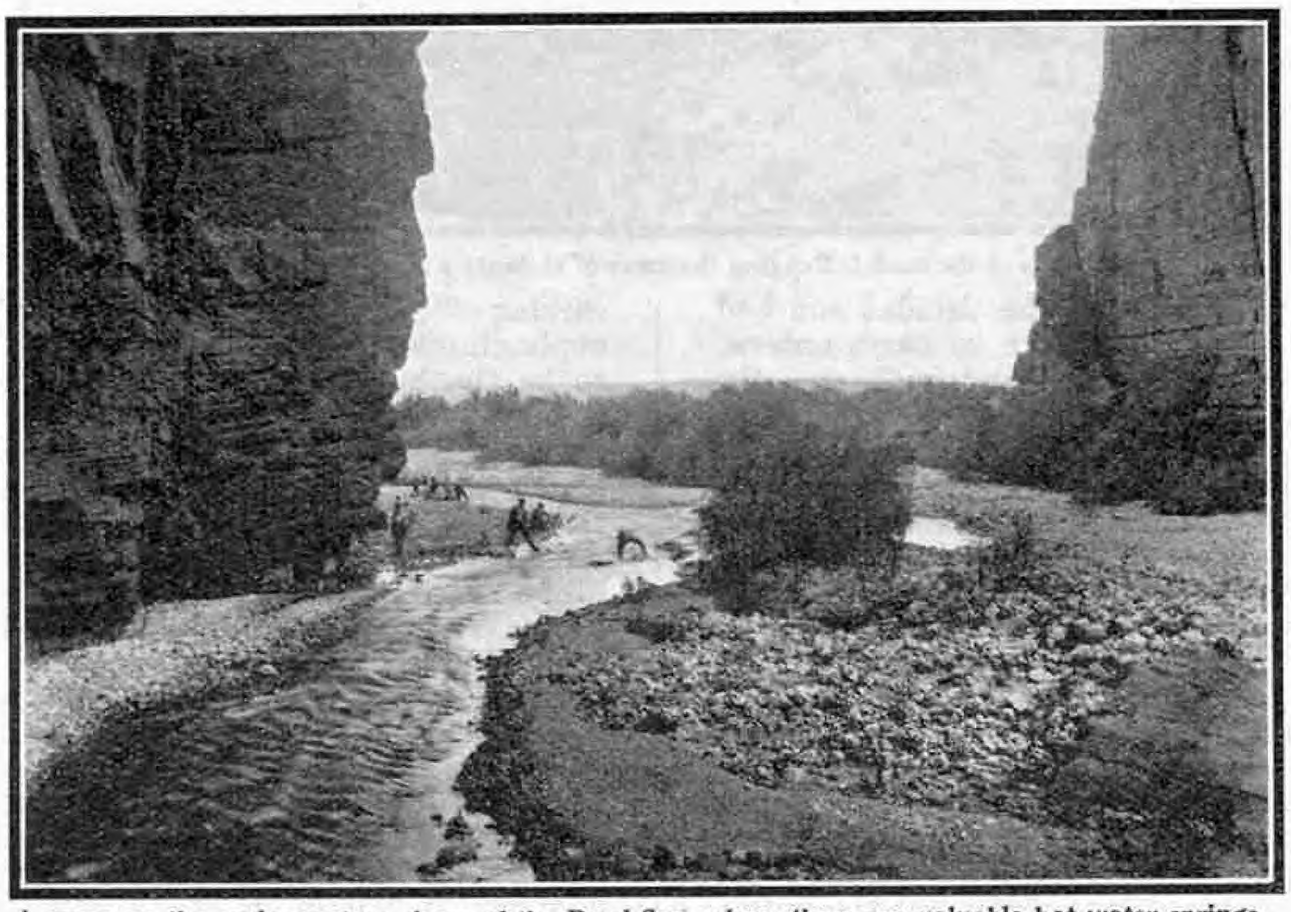
The neighbourhood of Cheltenham contains many such reminders of stages in the history of our country, for in addition to the barrows there are remains of several Roman villas. Some of the Roman remains in the district have been excavated by pupils of the Cheltenham Grammar School, which I attend, under the direction of Mr. Key, their History Master.

N. ALLSWORTH (Cheltenham).

A Visit to the Dead Sea

The Dead Sea, the lowest-lying stretch of water in the world, is appropriately named, for there are practically no signs of life on its shores except in the coolest months, when visitors make their appearance, or when parties of hunters seek out the wild boar to be found on the eastern side. There is now a factory on the shore of the sea, where valuable salts are extracted from its waters; but this seems out of place in its wild surroundings.

Huge rocks line the shore of the Dead Sea for many miles and these afford a wonderful picture, the scenery in many respects reminding me of parts of Derbyshire. Until recently little was known of the many hot mineral springs that gush from the towering rocks, but now bathers of every nationality seek their waters and the Dead Sea is becoming a popular resort. The favourite spring issues from basaltic rock in the gorge of the Zerka Stream, which is on the farther side of the Dead Sea from Jerusalem, and is reached in boats towed across the salt water. After mixing with the colder water of another stream, the hot liquid flows into the Dead Sea, and where it enters has a temperature of 130 deg. F. to 140 deg. F., and is just cool enough for paddling.

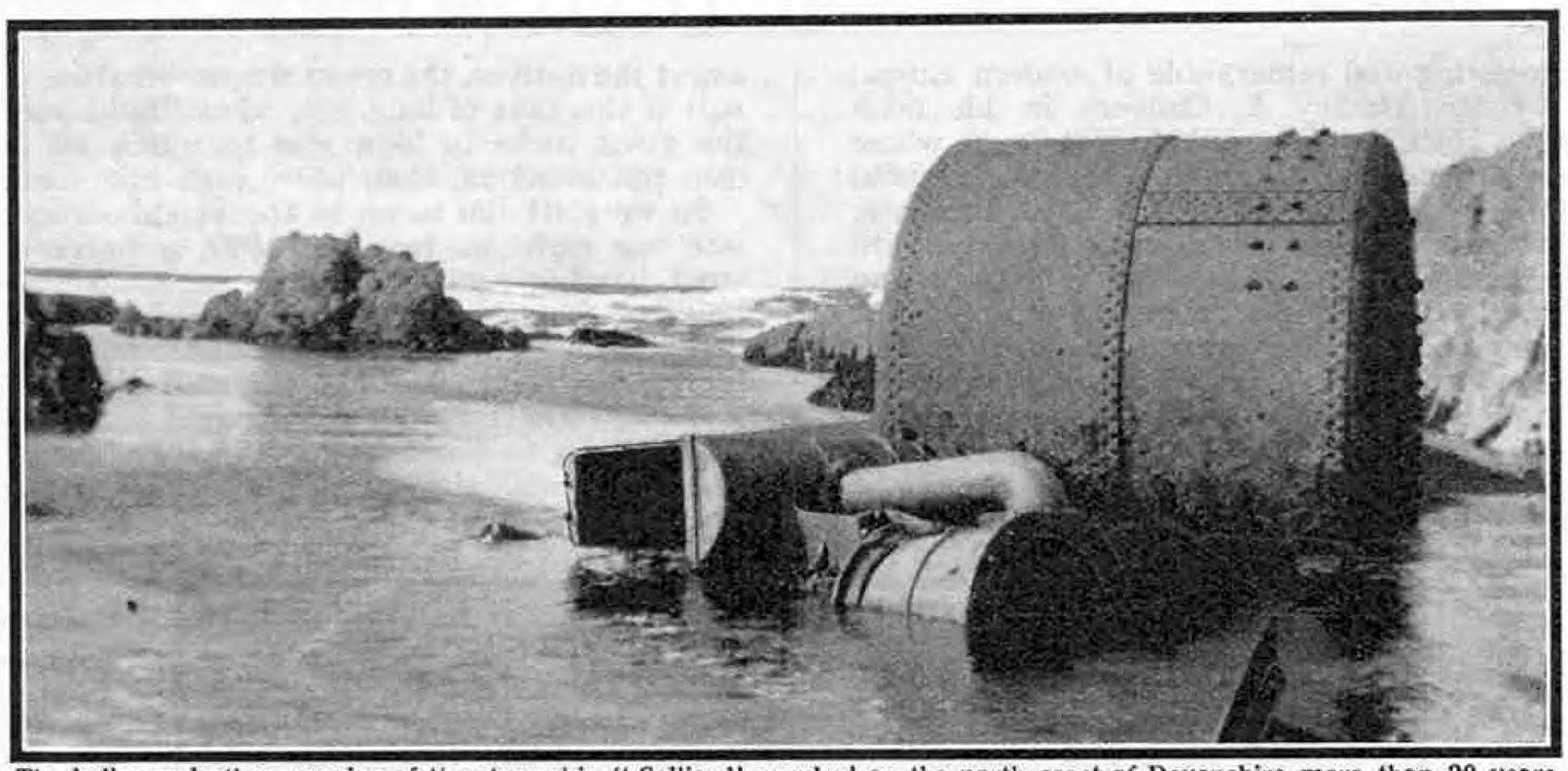


A scene on the rocky eastern shore of the Dead Sea, where there are valuable hot water springs. Photograph by H. H. Marsh, South Kirkby.

There is another famous spring about five miles away from the one I have described, and there the Romans built a small bath in order to obtain the benefit of its waters, which are charged with sulphur as well as with salts. There is iron in the water of the Zerka River, but at present the healing waters of the Dead Sea region run largely to waste in country that is almost a desert.

A shed has been erected on the Palestine side of the Dead Sea for the benefit of bathers. In it they can take fresh water shower baths after a swim in the salt water of the sea itself, in which of course they cannot sink. An Arab manages the shed, in which refreshments can be obtained, and probably in time a modern hotel will be erected on the site for the accommodation of tourists interested in this historic spot.

H. H. MARSH (South Kirkby).



The boiler and other remains of the steamship "Collier," wrecked on the north coast of Devonshire more than 20 years ago. Photograph by R. Green, Birmingham.

The End of a Famous Vessel

The upper photograph on this page shows the boiler of the steamer "*Collier*." On 28th January, 1914, this vessel struck Rockham Shoal, Morthoe, on the north coast of Devonshire, and was beached close to Bull Point Lighthouse. The crew were safely landed at Ilfracombe, but the vessel itself became a total wreck. The boiler and parts of the ship have remained on the beach at Morthoe since the wreck occurred, and I photographed them there a short time ago.

The "*Collier*" was built in 1849 for the Bristol Steam Packet Company. Later she seems to have been one of a fleet of steamers owned by Mr. Maples, who maintained the Newhaven-Dieppe and other services across the English Channel in the middle of last century. Railway companies were then prohibited from owning steamboats, and in 1847 the London, Brighton and South Coast Railway Company were heavily fined for illegally operating vessels between Newhaven and Dieppe. Mr. Maples then organised a service to run in connection with the trains of the company, which later secured the necessary powers to acquire steamboats. To-day the company forms part of the Southern Railway system, which owns more than 80 vessels of various types. These maintain passenger and goods services from various ports across the English Channel to France, the Channel Islands and the Isle of Wight, and the comprehensive service they give is a proof of the wisdom of removing the restrictions.

R. GREEN (Birmingham).

Southward Ho, with Huberta

By E. S. Stokes

ONE of the most interesting and remarkable of modern animal stories was told by Mr. Hedley A. Chilvers in his book "*Huberta Goes South.*" Huberta was a hippopotamus, whose thousand-mile wanderings from St. Lucia Bay on the Zululand Coast to a point in the Peddie District of the Cape Province, and extending over two and a half years, were followed with close interest not only in South Africa, but also in Europe and America. Huberta brought wide publicity to the Union. She was accorded what even distinguished men are often unable to merit—a laudatory leading article in one of the most powerful London newspapers, and mention in that journalistic holy of holies "*Punch.*"

The penner of the following brief Huberta pictures was associated with Mr. Chilvers in his book, through the contribution of a section treating of the national parts of this country.

On the morning of Thursday, 22nd November, 1928, Huberta first wandered into the news. She appeared, all unheralded, near the hamlet of New Guelderland, on the North Coast of Natal, and about 50 miles from Durban. Indians working in sugar-cane fields were startled to hear a hearty bellow, and seeking the source of the interruption, saw a hippo. Those Indians hastened to put distance between themselves and the trespasser, and Huberta (at that date she had not been christened) gave full heed to the urge of her appetite, the meal proving disastrous to three or four acres of the crop. New Guelderland folk mustered to glimpse the visitor, and at first she sought solitude in a nearby thicket. But having pondered, she decided she had not, like the rose of immortal verse, been born to blush unseen, so of a sudden swept from her sanctuary. And such was the seeming fury of her appearance that those who had gathered to see her cast aside the dignity of restraint and scattered wildly.



Footprints in the sand ! Reading the story of Huberta's remarkable journey.

Huberta had never been photographed, and from her reception of the cameraman who presented himself it was clear she had no wish to remedy the omission. When the photographer approached she snorted loudly and dashed at him with an alarming quality of speed. But she missed her mark, due to the agility of her target.

The photographer, a newspaper representative, was determined that Huberta's features should illustrate the printed tidings of her coming, and while he kept his camera in readiness, persuaded a venturesome soul to creep cautiously up to the hippo and tweak her tail. The ruse had the desired effect. Amazed at the indignity inflicted upon her, the victim of the trick looked up, and the camera clicked. The incident of the picture perturbed the hippo, for she moved her quarters almost at once. By 23rd November she had reached the Umvoti River. In the course of the trek she made heavy meals from sugar-cane crops, prompting a police officer to remark that from indications the sugar industry would find her a costly visitor. Meantime the ukase had gone forth from the provincial authorities that, being royal game, she was not to be harmed.

Three weeks later it was reported that Huberta had established a temporary home at the mouth of the Mbozama River. Natives living in the vicinity would not be shaken in the belief that the hippo was the reincarnation of the old-time Zulu chief, Chaka, visiting the scenes of his red and ruinous reign. Hereabouts, assert the natives, the ocean waves, breaking on the shore, murmur still of the days of long ago, when Chaka was wont to adjourn to the great rocks in high glee to watch his erring subjects flung into the breakers, then alive with man-eating sharks.

So we shift the scene to the neighbourhood of Stanger, where late one night in January, 1929, a party of Indians sharing a stout bamboo and daub shack were much alarmed by a sudden bulge in the side of their homestead. Considerable pressure was being brought to bear from outside, but the Indians were much too startled to move while the wall creaked and swayed. After a few minutes the bulge disappeared. Then the Indians ventured out-of-doors, to discern the spoors of Huberta, heroine of a hundred doughty deeds, who, passing the shack on her meanderings, had leaned a fraction of her weight against the structure while she sought wayside rest.

One night Huberta brought herself to the notice of the bandsmen of a native society conducting its operations at a little place not many miles to the north of Durban. As she went her way she heard a great blare from brass instruments, and mistaking the sound for a call from a creature of her kind, was much heartened thereby. Meanwhile, to the euphonium player of the band one of the greatest moments of his life seemed at hand. The composition receiving vigorous attention was Tschaikovsky's "1812" Overture, commemorating Russia's victory over Napoleon's army. Gradually the "Marseillaise" is drowned by the Russian national anthem, the swell of which plainly peals of triumph, while the sinking "Marseillaise" gives sure notes of overthrow. The euphoniumist was to do great work. For the most part, his were to be the blasts proclaiming the defeat of France. Better still, the belle of his choosing was seated in the hall, to listen and admire. In his eagerness he struck the Russian triumphale a beat or two ahead of the other bandsmen; but Huberta, loitering outside the building, had no objection to that.

The player of the euphonium blew with great gusto, and the hippo roared out her answer to what she regarded as a mating call. What a scattering of the band ! In frenzy, the performers leaped into the night. Only the belle, come to marvel and applaud, remained rooted to the floor by terror. But when Huberta put her huge head in at the door, the girl was roused to action. Seizing the shining euphonium, with all her might she hurled it at the intruder. Such a reception was not to the hippo's liking. She withdrew, and with her went the instrument which, falling under her body, was kicked and rolled as she walked. Hopelessly damaged it was in its rough passage; hopelessly damaged, too, in the girl's sight, was the reputation of its player.

On the night of 3rd June, 1929, all became agog at Sydenham, near Durban, when it was bruited abroad that Huberta had ambled seemingly out of the blue and was indulging in a liberal repast offered by the cabbage-patch of a local dairy.

Notwithstanding her bulk, the pachyderm was surprisingly adept at coming and going unseen, and the only evidence of her visit to Sydenham might have been a devastated vegetable-ground had it not been for a mule. This animal, in a stable near the cabbage-field, sensed a strange presence nearby, and set up a hullabaloo of snorting and stamping. This prompted three natives to hasten an investigation, armed with a hurricane-lamp.

Huberta, mild-mannered usually, did not lightly accept interruptions at her meal times, neither had she any partiality for hurricane-lamps; and the natives became aware of a huge form advancing upon them. With common consent they fled, flinging away the lamp as they ran, perhaps that they might be swallowed in the darkness. They had glimpsed the wide open mouth of their pursuer, and although ordinarily barbed wire fences are not in the nature of minor obstacles, such an obstruction collapsed before the combined weight of the panic-impelled blacks. One of the natives sought refuge in a thorn-tree. Unhappily for him, in his haste and the darkness he had not seen the thorns. These happenings were not lost to the hearing of a cow contemplatively chewing the cud in an adjacent paddock, and before long she had leaped the fencing of her enclosure, and was taking an active part in the general commotion.

Huberta disappeared from ken, although her spoors later revealed that she returned twice during the night to the cabbage-patch to conclude her meal. Daylight inspection went to show not only that she was blest with a particularly hearty appetite, but that she had received no instruction in the rudiments of economy, for she had trodden to pulp scores of cabbages, which she had ignored as diet.

It was in the wee sma' hours that a Zulu ricksha puller and his fare, travelling along the main thoroughfare of very modern Durban, had a demoralising surprise. Huberta, trudging along West Street, had been much struck by the gay effects from a chemist's shop window, with powerful lights shining through great bottles of green, red and purple-coloured water. She had halted to puzzle things out, and as she stood there, metaphorically scratching her head, the ricksha came upon the scene. The ricksha puller considered discretion the better part of valour, and as the fare had no objection to this course, the hippo was left to plod away and disappear into the night.



Huberta, whose 1,000-mile journey, extending over 2½ years, is described in this article.

Progressing along the Natal South Coast Huberta one day wandered into the resort of Anerley, just over 70 miles from Durban. This was a red-letter occasion for the natives, who hastened to kindle sacrificial fires and slaughter lambs as peace offerings to the hippo, which harboured, they too declared, the spirit of the blood-thirsty Chaka. Yet even while they sought, through their flames and offerings, to appease the spirit, supposedly lurking within Huberta, they took precautions against the demands of the visitor's appetite, of which they had heard disturbing accounts. "Better be sure than sorry," they murmured, as they denuded their fields of vegetables.

About the beginning of October the pachyderm looked in at Port Shepstone, and took up her quarters in and about the Umzimkulu River. This coming highly pleased the natives, who regarded her as a witch doctress of great powers who had assumed animal form. Much-needed rain synchronised with the arrival of Huberta at Port Shepstone, and the superstitiously-inclined gave her credit for the downfall. But while they worshipped, they took the precaution to offer their obeisances from a safe distance. A Port Shepstonian with a bent for statistics asserted that the hippo while in this vicinity, accounted for well over 1,000 cabbages, and a good many bags of potatoes.

Port St. John's, that peaceful and picturesque place described in the official guide books as a corner of content, is perhaps one of the last spots in which one would seek sensations. Even so, in the early morning of 25th March, 1930, a municipal overseer of the resort, observing in the darkness a dimly-defined bulk of a huge animal quietly grazing on a grass plot on the town's market square, flashed an electric torch, and was flabbergasted by what he saw. Huberta had arrived. The man lost no time in rousing nearby sleepers, to whom he reported his experience. But those who hastened to the square drew a blank, and read the disturber of their slumbers a homily on the advisability of temperance.

That evening a meeting of the Port St. John's municipal body was to be held, and one of the councillors, crossing the market square on his way to the town hall, discerned what he took to be an overgrown ox placidly enjoying the grass. Like the overseer he flashed a torch, to find himself looking into a face the like of which he had not counted on seeing at such near quarters. Two closely-set eyes glinted from the huge head, while red nostrils in a pink muzzle added to the terror of the moment, and the councillor was not reassured to note the mass of body outlined in the uncertain light. Huberta made overtures. She advanced. But the representative of civic administration did not await further developments. Rightly or wrongly, he was credited by some with a record sprint to the town hall. There to his colleagues in office he related his adventure, and forthwith the council and town clerk marched *en masse* to the scene of the invasion. Thus it was that soon a battery of torches brought Huberta well into the limelight. But the hippo acted at once, her charge completely routing the approaching party. No further investigation was made that night into her affairs.

Next evening practically all the town's residents assembled on the market square. Electric torches were in readiness, and dozens of motor cars were drawn up, their headlamps in position to illuminate the scene. By and by Huberta blundered along, instantly becoming the centre of a blaze of light. Men shouted, women screamed, and children and barking dogs added to the general clatter. Huberta was taken aback. She squatted on her haunches, and meditated for a few moments. After due thought she shuffled creekwards, the crowd following at a respectable distance. She disappeared in the bush, and at 10.30 all was reported quiet on her front.

On the 13th January, 1931, a report came that the hippo had again splashed into the news. The lure of the sea had held her awhile, but she subscribed to the "variety is the spice of life" idea, and for a time ruminated and rusticated in the neighbourhood of Kingwilliamstown. In the course of her career she held up several trains, and on Sunday night, 8th March, was again guilty of the offence. Mr. Bird, driver of a goods running between Berlin and Kingwilliamstown, in the circle thrown by the engine's powerful headlight discerned a large obstruction on the line. He reduced speed at once, bringing the heavy train almost to a crawl, and was soon able to recognise Huberta stretched across the metals. The locomotive, at the driver's bidding, emitted vibrant blasts as a warning to the trespasser to give the right of way, but it was only when, advancing at what might almost be described as snail pace, Mr. Bird extended persuasion to the hippo by nudging her gently with the cowcatcher that she deigned to lumber away.

Huberta was nearing her journey's end, and late in April the sad news was flashed from Kingwilliamstown that she had been shot. With one accord, Parliament, press, and public demanded the punishment of the destroyers, who had robbed the Union's people of a vagabond to whom they had come to give real affection. A distinguished legislator, addressing the House of Assembly, said, "All South Africa has been distressed to hear of the death of the famous national character, Huberta, the Hippo, reported to have been shot. What steps have been taken to bring the culprit to justice?" "I have ordered the police to investigate," was the reply of the Minister concerned.

A few weeks later four men, found by the court to be responsible for Huberta's death, received their sentence.

For permission to reprint this interesting article we are indebted to the courtesy of the Editor of the "*South African Railways and Harbours Magazine.*"

Telescope Built by G.W.R. Mechanic

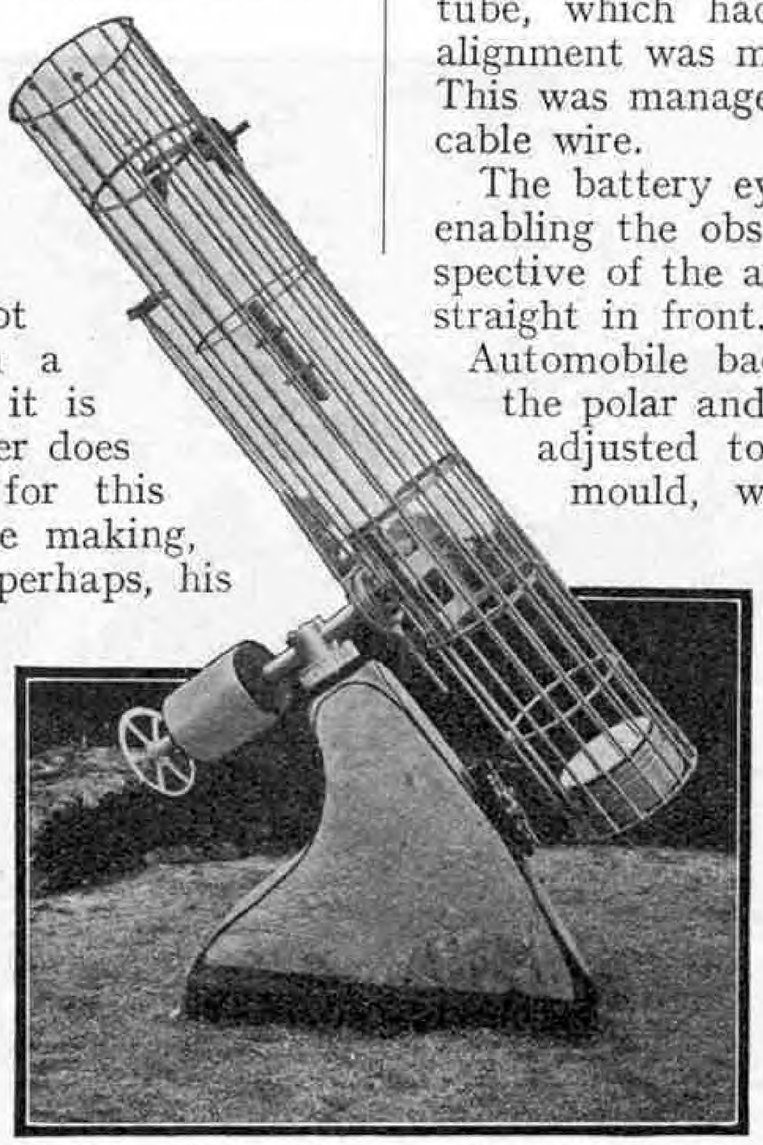
A Fine 12-inch Reflector

IS it possible to work to a millionth part of an inch? By most people, apart from scientists who make a practice of doing the seemingly impossible, this question would be answered by a negative; but Mr. Edwin Hopper, who is employed in the "O" shop of the Great Western Railway Company's locomotive works at Swindon, has accomplished the feat, and regards it as just a part of his recreation.

Such a degree of accuracy is not necessary to build an engine—even a Great Western Railway engine—but it is essential in the work which Mr. Hopper does in his leisure. The hobby calling for this amazing accuracy is that of telescope making, and he has just completed what is, perhaps, his finest work, by making a 12-in. reflecting telescope, equatorially-mounted and clock-driven.

This instrument has taken more than two years to construct, and is the largest in Wiltshire. The accompanying illustration will give some idea of the immensity of the task which Mr. Hopper has successfully accomplished.

The purchase price of such an instrument would probably be in the neighbourhood of £400, and even to make, the cost is in the hundreds. On this account Mr. Hopper had to compromise to some extent by utilising second-hand material for the mechanical gear.



The 12-in. reflecting telescope constructed by Mr. E. G. Hopper, a mechanic in the G.W.R. Swindon Works.

Absolute perfection had to be obtained in the production of the speculum and the flat, otherwise an observer would be seeing things that were not there, and failing to see the things that were. The grinding, polishing, figuring, and testing of the speculum and flat mirror were practically a lost art, but that difficulty was overcome by the use of text books and infinite patience. The degree of patience required was such that after a whole bank holiday spent at "figure and test," "figure and test," Mr. Hopper found that he was a few millionths part of an inch worse off than when he started the day, and the process had to commence all over again!

Specially annealed glass, 2½ in. thick, was used for the speculum, and it was the grinding of this glass to the accuracy of a millionth part of an inch that presented one of the great difficulties, the "coaxing" representing in money about 49 times the cost of the glass. A special machine was built for grinding and polishing this speculum, the table of the machine rotating once to 150 strokes of the tool, which rotates in the opposite direction. Grinding was commenced, using a lead tool and varying grades of carborundum, with water, and this led up to the final polishing with a hard pitch tool and washed rouge and water, the rouge being allowed to settle before pouring off the coloured water for use.



Mr. E. G. Hopper.

Another problem was in connection with the built-up tube, which had to be so constructed that optical alignment was maintained in any conceivable position. This was managed by utilising steel tubes braced with cable wire.

The battery eye-piece is fitted on a revolving stage, enabling the observer not only to stand upright, irrespective of the angle of the telescope, but also to look straight in front.

Automobile back axles and housings were used for the polar and declination axes, the polar axis being adjusted to the local latitude, inside a wooden mould, which was afterwards filled with reinforced concrete to form a solid stand weighing nearly a ton. This, by virtue of its own inertia, effectively prevents any road vibration (which would be fatal to good observation) reaching the eyepiece.

The 12-in. mirror is a paraboloidal curve of revolution and its truth to a millionth part of an inch has been tested and proved by the rigid and unfailing Foucault test, the most beautiful and delicate test that the ingenuity of the human brain has yet conceived. The flat mirror is also tested to the same accuracy by the light interference test.

Very few amateurs have the chance of experiencing the thrill of seeing those secrets of nature that are only discovered by an instrument of this capacity. Ninety-three per cent. of the light collected by the large silvered mirror reaches the pupil of the eye applied to the eyepiece, and gives a penetrating and illuminating power millions of miles beyond the ordinary scope and range of smaller instruments. The planet Jupiter, which appears as a point of light to the naked eye, looks larger than our Moon when seen through this instrument, and the shadow of one of his own moons was clearly seen as a black circle on the surface of the planet when it was last observed. The snow caps on the polar regions of Mars can be seen to diminish as its summer advances and to expand with the approach of winter. Many stars that to the naked eye appear single are revealed by the telescope as double, or even triple, stars.

It is a wonderful tribute to Mr. Hopper's skill and patience that he has produced an instrument such as is rarely seen outside the big scientific institutions.

We are indebted to the Editor of the "*Great Western Railway Magazine*" for permission to reprint this interesting article and illustrations.

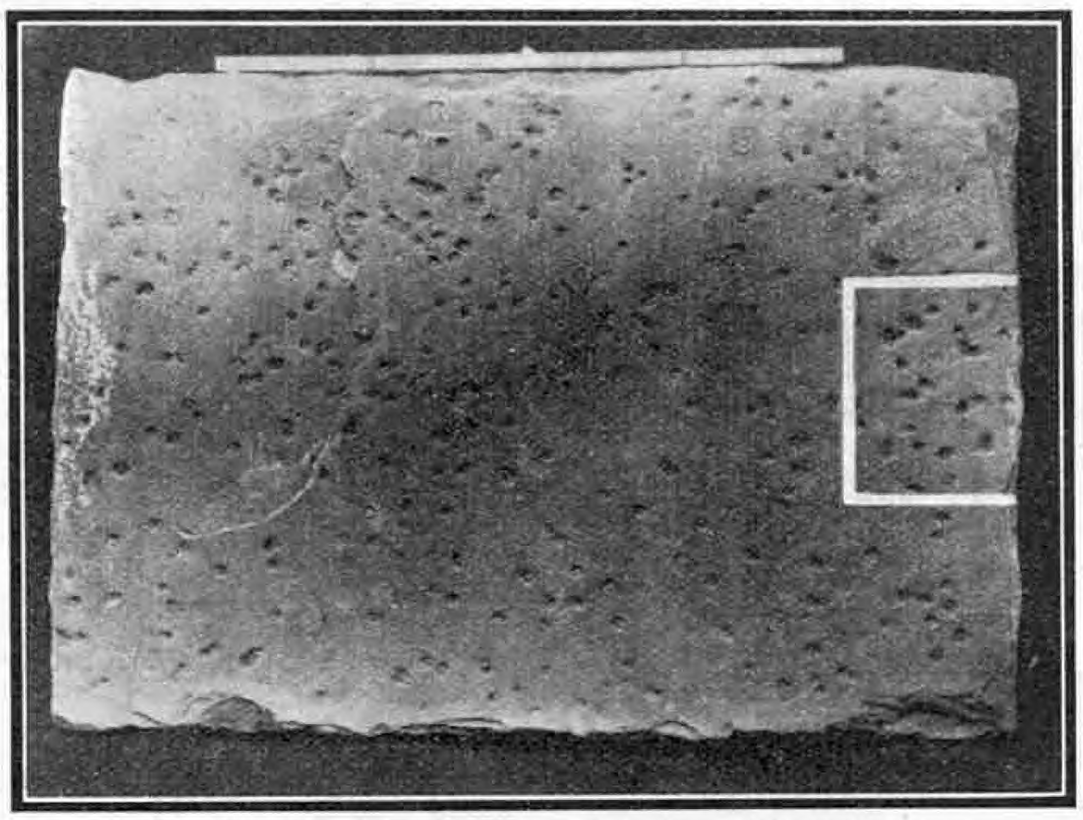
A Hailstorm Millions of Years Ago

Nature's Geological Manuscript

By W. Coles Finch, M.Inst.C.E.

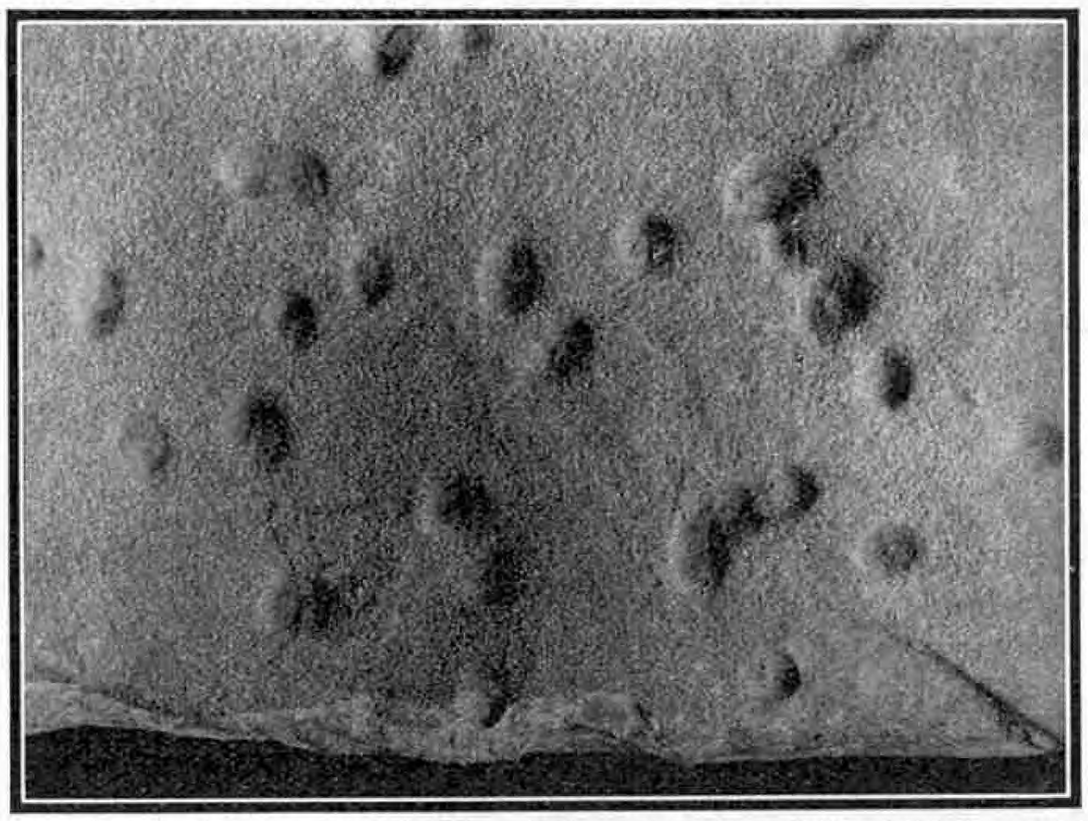
ALL ancient manuscripts hold for us a peculiar fascination, but the records of the rocks have a special attraction. On them we find imprinted the trails and footprints of some of the strange early creatures fitted to live under the conditions existing long before man and the higher mammals and birds appeared. Here, however, we are particularly interested in the record of the familiar hailstorm, a record dating back millions of years, when Nature was leaving her finger-prints on the manuscript of time, to excite our wonder and admiration to-day.

Our first illustration shows us an old paving stone from our public streets which, worn thin by the ceaseless tramp of busy feet, had served its time and stood useless and derelict, waiting only to be broken up. It became saturated with rain and exposed to frost, and as the result each winter a thin flake peeled off. These leaves of the manuscript bore no special message for us, except that each thin layer of this flagging sandstone was parted from the one beneath it by a shining, pearly coat of mica, bright with an almost metallic lustre. This is often found lying along the plains of separation in the sedimentary rocks, and while to the uninitiated it is a matter of little moment, to those of an enquiring turn of mind it conveys much.



A slab of sandstone showing the imprint of a prehistoric hailstorm.

These paving stones are a sedimentary rock consisting of earlier rock broken up into fragments, carried by rivers down to the sea, and deposited layer by layer in the form of fine sand by each receding tide. In calm weather, when the tide is peacefully going out, the last form of matter to be deposited by the water on the sediment is mica. This is a mineral, but although it is heavier than the sand silt it is deposited last, and the explanation of this is interesting. Mica consists of thin flakes or scales, sometimes not more than 1–300,000th part of an inch in thickness. Hence, though heavier, the flakes remain longer in suspension, and are the last to be deposited, giving the sandstone its laminated or layered structure. The writer has often watched the mica being deposited by the receding tide on the sands around our coast, for Nature still pursues to-day the course she followed millions of years ago.



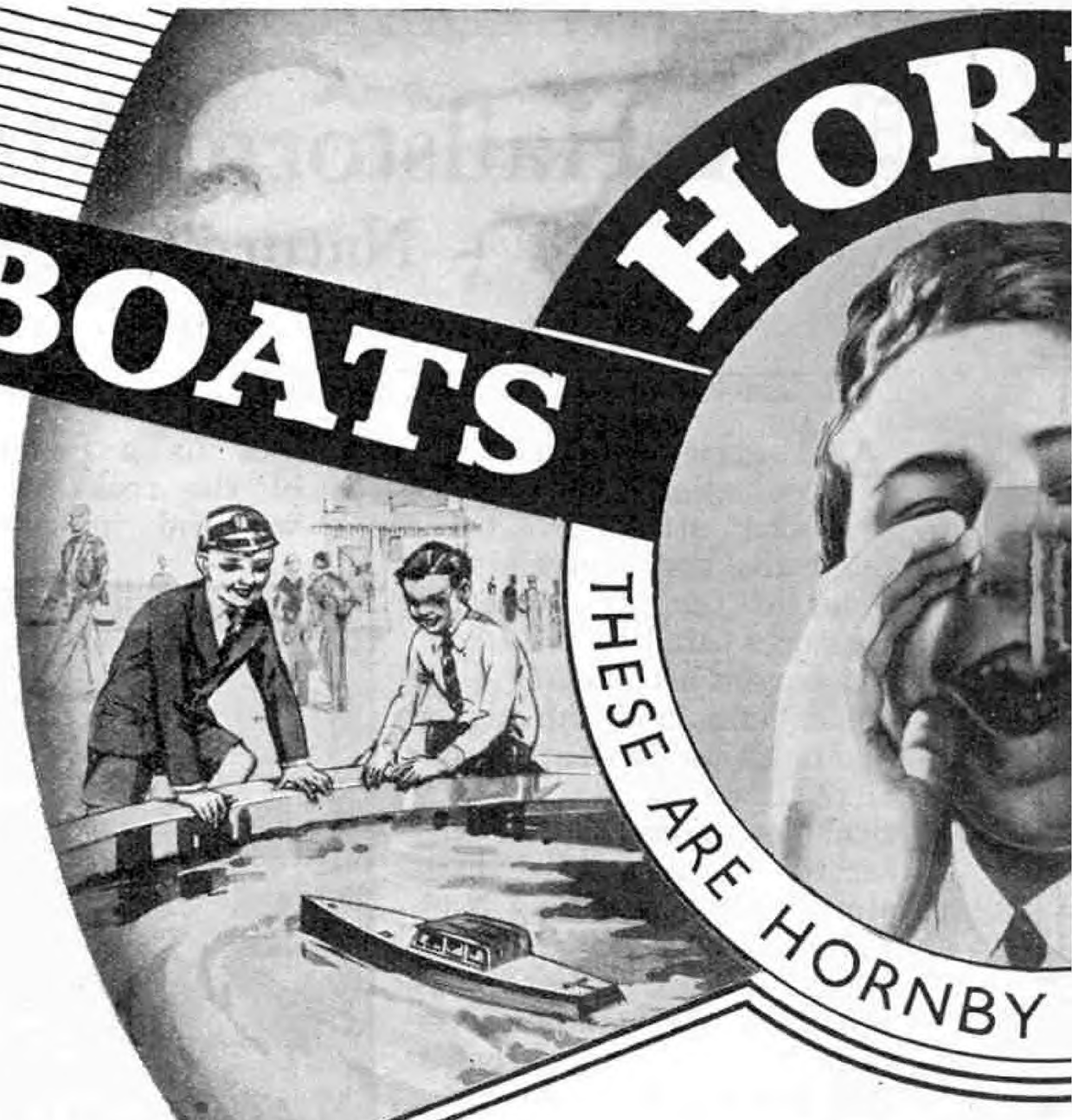
An enlargement to two-thirds full size of the small portion of the slab indicated in the upper photograph.

Let us now return to our old foot-worn paving stone. Another winter passes, another layer is burst off by the frost; and this time a revelation greets us, telling in no uncertain language, by the profusely scattered indentations on its surface, its story of ages long past. We can picture the ancient receding tide depositing the sand sediment, followed by the pearly coating of mica. We picture the fierce sun quickly baking the surface of the now exposed mud-flat. The next tide repeats the process, adding its layer; and again the sun dries its surface as the tide recedes. Dark threatening clouds overspread the sky, and a heavy tropical storm breaks, hailstones of varying size being hurled from the fringe of the storm on to the firm surface of the mud-flats. In this slab of sandstone we have a perfect example of the manner in which the memorial of prehistoric hailstones is preserved to us.

A closer inspection of the stone reveals the fact that the hailstones fell with great force, for not only was the top layer of the stone, $\frac{1}{4}$ in. in thickness, deeply indented by the icy pellets, but the previously deposited layer of sediment also was profusely and deeply marked by the same hailstones. Aided by the mica coating the top layer was readily removed, and the pittings of the under coating were then found to be identical with those of the upper layer. But for the aid of the minute mica flakes, this secret of past ages would not have been revealed. Some of the pittings are over $\frac{1}{2}$ in. in diameter, and they indicate the direction of the wind by the slanting impact of the hailstones.

A flake from this stone was sent to the Curator of the London Geological Museum, who read its secret, and agreed with the writer in all his deductions.

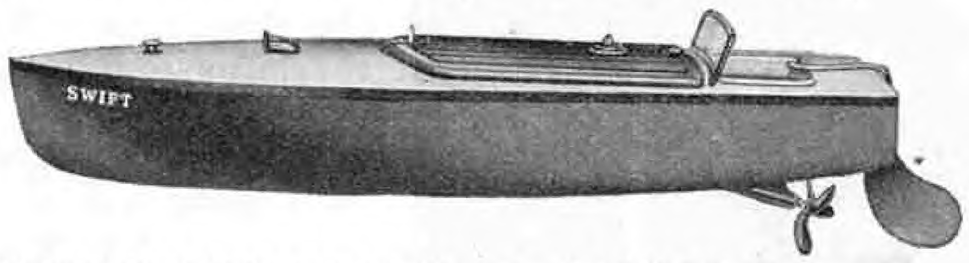
SPEED BOATS



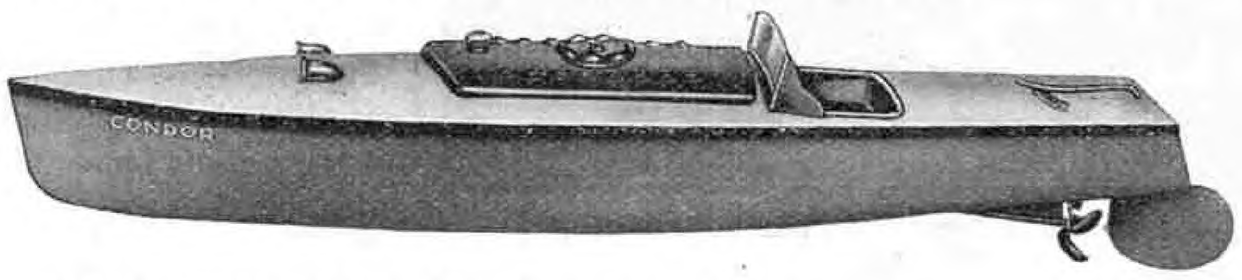


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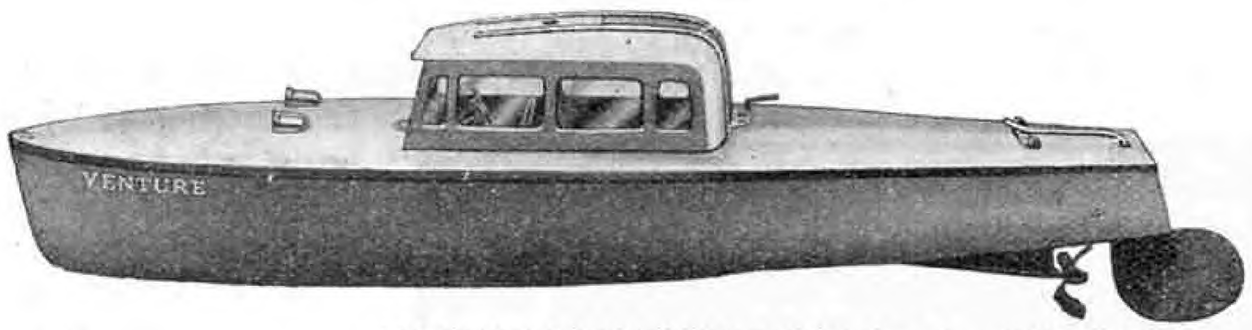
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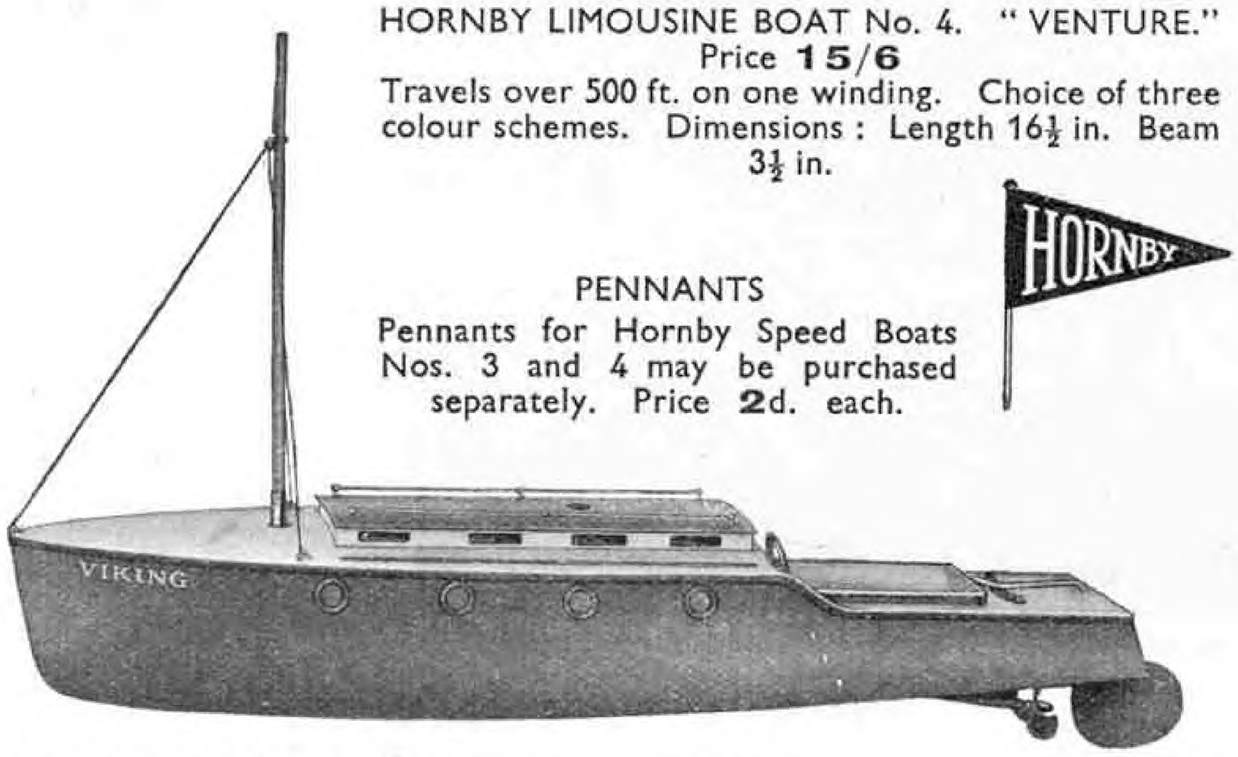
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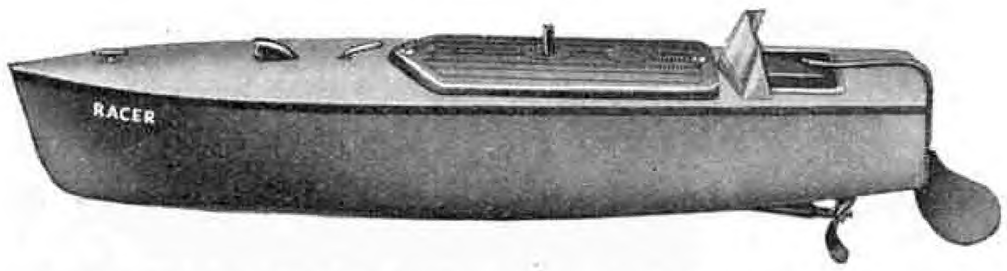
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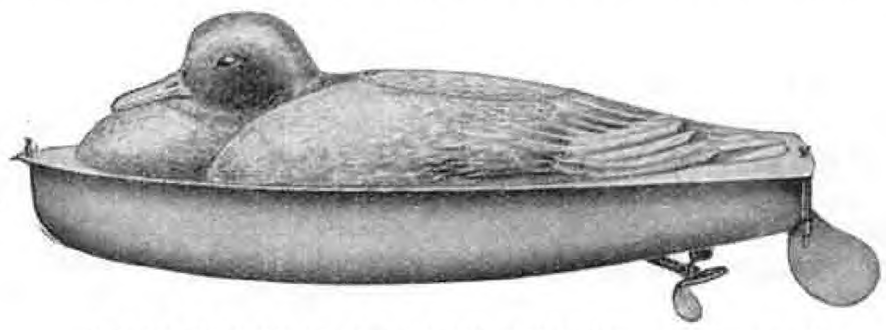
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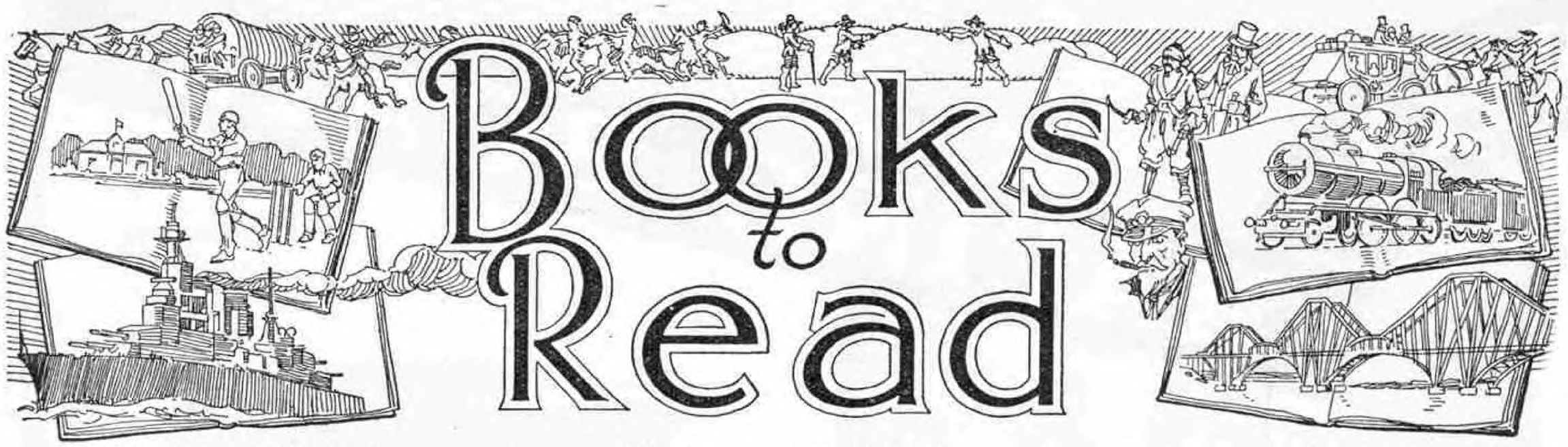
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"The Yeoman's England"

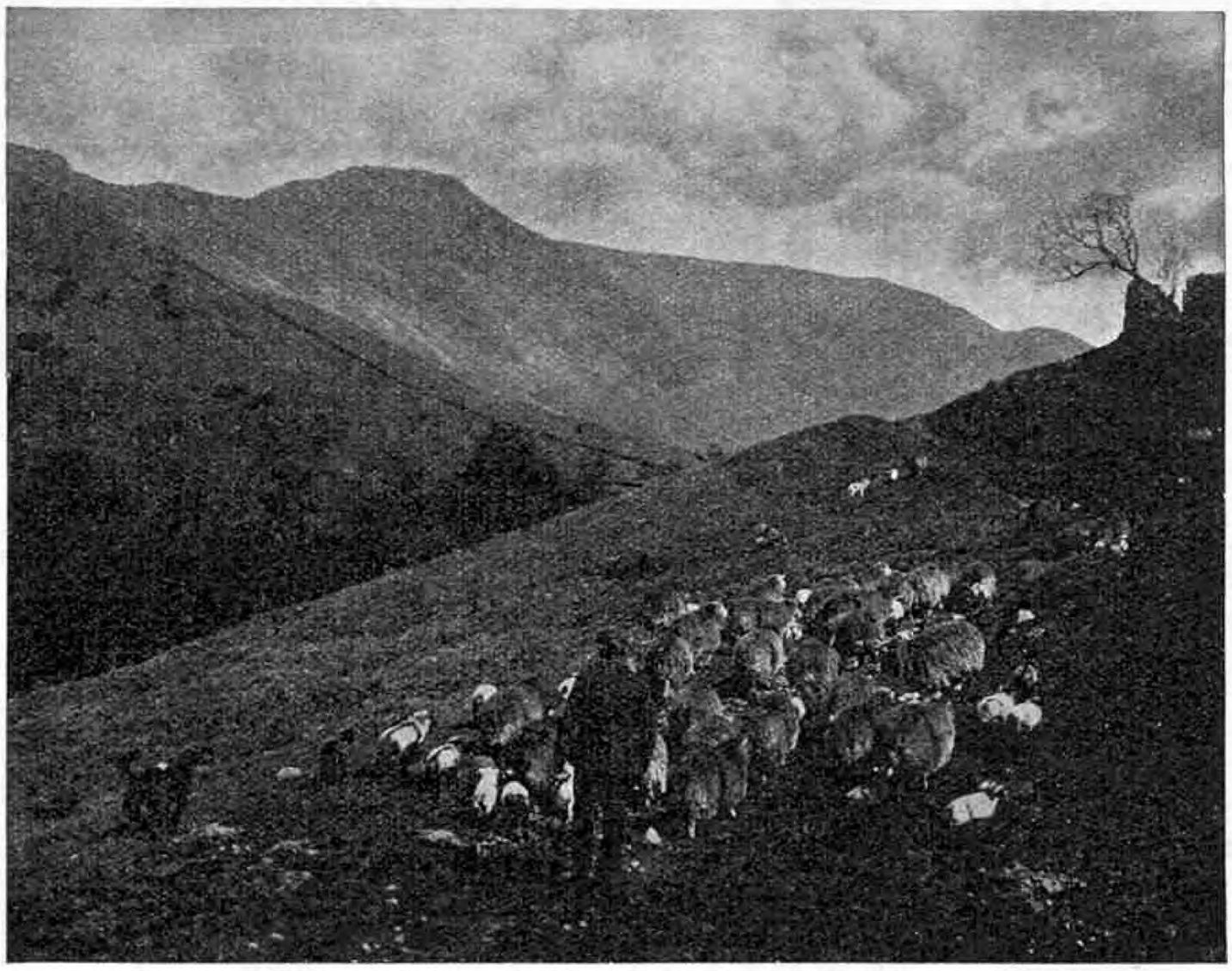
By Sir William Beach Thomas. (MacLehose. 8/6 net)

The flow of books on various aspects of the countryside shows no signs of decreasing, and seems to be passing the bounds of reasonableness. The trouble is that few of these books contain anything that is original, and fewer still are worth reading on account of literary value. *"The Yeoman's England,"* however, has definite claims on our attention, for though it may not contain much that is really new, it approaches its topics in an original manner, and has a charm of style that is exceedingly attractive.

In his introduction the author says: "Now, as it seems to me, a great many people have written memorably about little bits of England intimately known. No one has written well of England as a whole." We are thus made acquainted with the general scheme of the book, which is to deal with the English countryside in general as it appears month by month throughout the year. The book is, in short, England seen by a naturalist with exceptional powers of observation, and the rare capacity for describing what he sees in simple language that brings the scene before our eyes. We are taken through the months one by one and shown how the landscape changes as the days pass. In addition the life stories of the familiar creatures of the wild are dealt with briefly but interestingly in a manner that makes us long to be out of doors and to see these things for ourselves.

The book illustrates well the infinite variety of English country life. The author lays stress on this, and also on the fact that, contrary to the usual belief, "the country of England is essentially man-made." One result of this is that our island and its inhabitants, past and present, are scarcely separable, and the country is so intensely human that it can only be understood by walking through it and closely watching its people and its furred and feathered inhabitants as they follow their customary pursuits in its changing aspects.

The book is illustrated by 16 full-page photographs of quite unusual interest.



Sheep on a Cumberland Fell. (From "The Yeoman's England," reviewed on this page.)

"The Carpenter's Tool Chest"

By Thomas Hibben. (Routledge. 5/- net)

The object of this book could not be better expressed than in the author's dedication: "This book was made for you, Tom and Hilton and Robert, that you might know something of the tools with which the world around you has been built and how these tools came to be. Then, too, I would like you to know about the carpenters, how they have lived and worked, built bridges and boats and buildings down through the centuries."

In the first section the form and use of the axe and the adze, the hammer, the vice, the plane and other tools are described, and their special virtues explained in relation to the purposes for which they were developed. Even the humble nail is shown to have an interesting story, and we learn that in former times every household made its own supply of nails, boys beating long rods of iron into shape at odd times during the winter in order to make a sufficient number to last through the year.

This section is followed by others dealing with the development of tools, and in these sections it is shown that toolmaking is at the very foundation of civilisation, and that even the names of the stages through which man has passed are those of the materials he used for this purpose. First came the Old Stone Age, with its crudely chipped stone tools, and this was succeeded by the New Stone Age, in which the practice of grinding and polishing was introduced. The discovery of metals and the employment in turn of bronze, iron and steel marked a great advance, for the more efficient tools then at man's command gave him increased scope for the display of constructional powers. Step by step the author traces the development of every tool now used by the carpenter, whether for measuring and setting out or for actual woodworking, and shows how they were improved, and new forms introduced, in order to fit them for their special purpose. Their history is traced through the great ancient civilisations down to that of the Romans, and the author gives valuable glimpses of the lives of those who wielded them, and of the people they served.

Then comes the equally interesting story of carpentry in the Middle Ages, when powerful craft guilds regulated the conditions in which apprentices were taught the trade, and laid down rules in order to ensure that all carpentry work was done thoroughly and efficiently. It was during this time that power first came into use with the introduction of saws driven by watermills, and the story is completed by an account of the invention of woodworking machines.

This brings the author to the part played by tools in craftsmanship. He remarks that "a craftsman is one who understands his tools and his material and uses them with skill and honesty." Whether the tool is a chisel or a planing machine matters little; it is the work done with it that counts in making the world in which we live more as we would like it to be.

Craftsmen and amateurs in woodwork will gain a new appreciation of the virtues of their tools from this fascinating account of their origin and history, and those who are not concerned with the practical side of woodworking will be interested in the connection between the development of tools and the rise of civilisation. The book is well illustrated with more than 200 delightful and accurate drawings of tools of all ages.

"The Progress of Science"

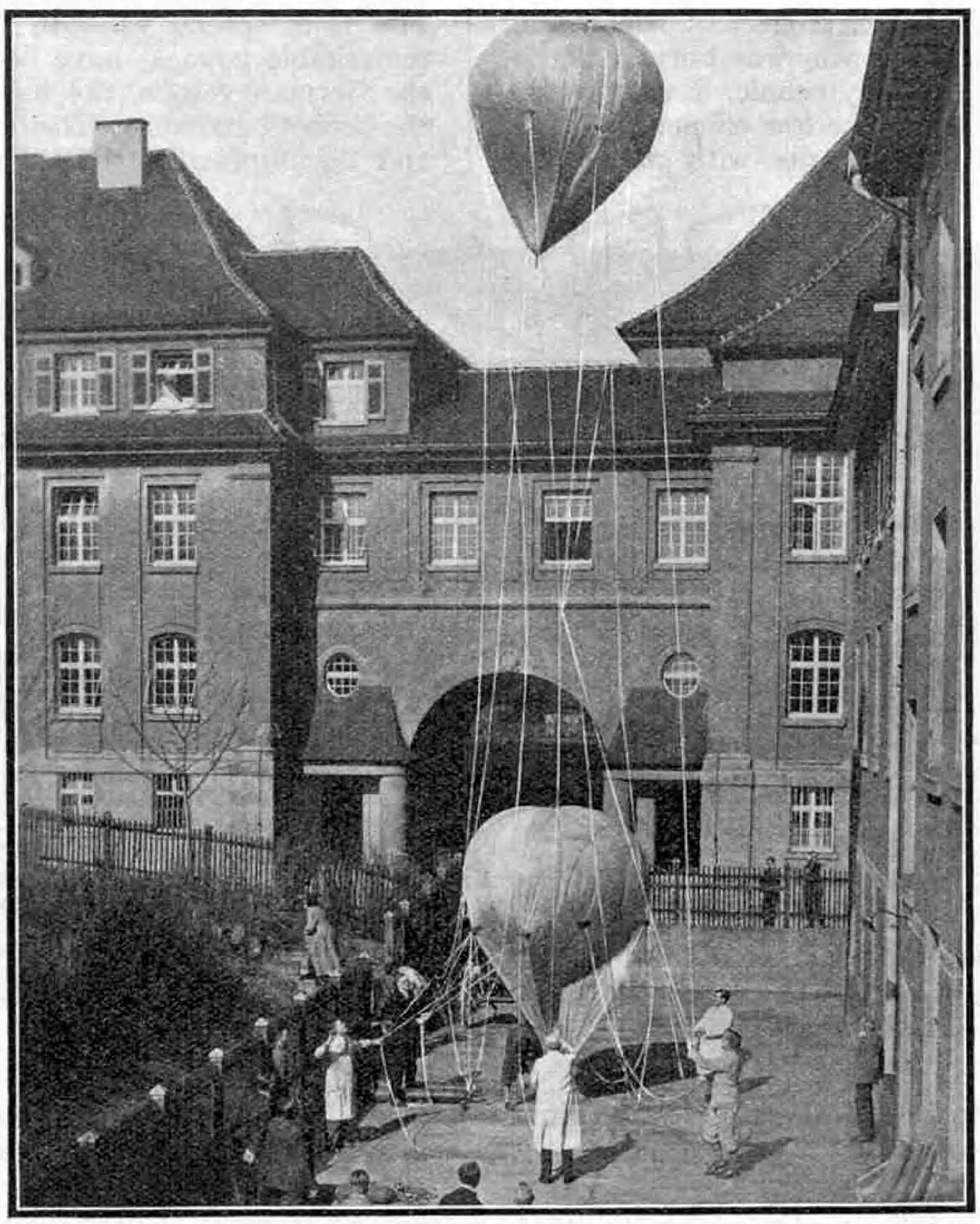
By J. O. CROWTHER. (Kegan Paul. 12/6 net)

To-day some knowledge of science is necessary for everyone who takes an intelligent interest in industry and in human affairs in general, and those who have had little or no scientific training have to rely upon books such as this if they wish to understand recent discoveries in various branches. Mr. Crowther is an excellent guide, for he is in close touch with scientific developments in all quarters, and he chooses topics that are both interesting and important.

The results achieved in scientific work are interesting in themselves, but we like also to learn something of the famous scientists responsible for them and of the spirit that animates them. Mr. Crowther seems to have had this in mind when planning the contents of this volume, for its earlier chapters deal with two laboratories that have become famous because of brilliant discoveries made in them, and a third that has made a very promising beginning. The Cavendish Laboratory at Cambridge is the first of these. It was founded 58 years ago, and early became famous as the scene of the discovery of the electron by Sir J. J. Thomson. More recently the first successful effort to split the atom by machinery was made in it by Drs. Cockcroft and Walton, who broke up atoms of lithium by bombarding them with incredibly swift atomic particles driven by the power of 125,000 volts. Mr. Crowther explains in full detail how this remarkable work was carried out, and illustrates his account by means of diagrams and drawings of apparatus that make the whole process clear even to those whose acquaintance with modern electrical science is extremely limited.

The next sections deal with the laboratory at Copenhagen that is the scene of the activities of Dr. Niels Bohr, whose achievements have earned for him a Nobel prize; and with an institution of the same kind at Kharkoff in Russia. Mr. Crowther has visited Russia, and his reports, and photographs taken in the Kharkoff laboratories, show plainly that the value of scientific research is fully recognised there, and suggest the possibility of really important and striking discoveries.

The remainder of Mr. Crowther's book deals with recent work in different branches of science. Among the subjects treated are the latest theories on the constitution of the stars and the Universe, including the interesting theories of Professor Milne, an English scientist whose ideas are now attracting attention. Cosmic rays are given special attention in a separate chapter, and the account of their discovery and the efforts to track down their origin reads like a detective story. We owe the record-making balloon ascents of recent years to attempts to show that the rays reach us from outer space. These ascents were in effect explorations of the unknown upper regions of the atmosphere, and the pioneer efforts of Piccard, the famous Belgian scientist who first reached a height of more than 10 miles, were as daring as the voyages of Columbus and the great navigators who followed him in revealing the New World to us. The risks that he ran were tragically shown by the catastrophe that overtook the Russian scientists who recently reached the record height of about 13 miles. Smaller balloons equipped with self-recording instruments also have been sent into the upper regions of the atmosphere to measure the intensity of the rays at heights up to 17 miles. The illustration from Mr. Crowther's book that is reproduced on this page shows balloons used for this purpose undergoing test at Stuttgart.



Balloons carrying self-recording instruments for measuring the intensity of cosmic rays, being tested at Stuttgart by Professor Regener. (From "The Progress of Science," reviewed on this page.)

Another astonishing discovery fully dealt with in the book is that of "heavy" water in which fish and other aquatic creatures cannot live, and that is destructive to seeds that sprout readily when moistened with ordinary water. This is always present in ordinary water, but in very minute proportions. It is separated by passing an electric current through water to which acid or alkali has been added to give it conducting powers, for "heavy" water is not readily split up by this treatment. Prolonged treatment is necessary and as yet the new kind of water is rare and costly. It is therefore tantalising to realise that in the past large quantities of this remarkable liquid accumulated in electro-chemical works must have been thrown away, its existence unsuspected! Finally Mr. Crowther turns to topics of a biological character that are no less attractive, and have not previously been dealt with at length in popular scientific works.

The book is illustrated by means of 11 plates and many drawings in the text, and can be recommended to everyone who is seriously interested in the progress of science and the story of its achievements in widely different fields.

"Modern Watch Repairing and Adjusting"

(N.A.G. Press Ltd. 4/- net)

This book has been written to meet the demand for a really authoritative and reliable source of information on all matters connected with the repair and adjustment of watches. It brings the most modern methods of working before the craftsman in a concise form, and includes the latest innovations in watch construction, including eight-day, jumping figure, date, and self-winding watches. All whose work is concerned with the buying, selling or repairing of watches will find the book a valuable aid; and although it cannot be regarded as a book for the amateur, readers who are interested in watch repairing will find it of great assistance in solving their problems. The illustrations are many and excellent.

"King Richard's Land"

By L. A. G. STRONG. (Dent. 5/- net)

The scene of Mr. Strong's romance is laid in the troublous times of the boyhood of Richard II, when a dangerous insurrection ended with the stirring episode of the slaying of Wat Tyler as he pressed the demands of his followers upon the young king at Smithfield. The two boys who are the heroes of the story accidentally become associated with a band of insurgent peasants marching on London, and after witnessing riotous scenes in the capital one of them is fortunate enough to bring about the downfall of Wat Tyler at the moment when the peasant leader threatens violence to Richard. This episode may not be historically accurate, but it brings the heroes into the king's favour, and in his service they make an adventurous journey by land and sea in which they narrowly escape capture by pirates. The story is excellently told and unusually well illustrated.

New Books

The undermentioned books, recently published, will be reviewed in a future issue.

SCIENCE TO-DAY
by Sir J. A. Thomson (Eyre & Spottiswoode, 8/6)

SECRETS OF THE RED SEA
by Henry de Monfreid (Faber & Faber Ltd., 12/6)

RAILWAY ENGINES OF THE WORLD
by Brian Reed (Oxford University Press, 3/6)

NATIONAL FLAGS
by E. H. Baxter (Warne & Co. Ltd., 3/6)

TRAGEDY AT TRINKET
by Brian Flynn (T. Nelson & Sons, 3/6)

THE STORY OF PETROL
by C. Webber (T. Nelson & Sons, 3/6)

LIFE AND ADVENTURE IN MEDIÆVAL EUROPE *by* R. J. Mitchell (Longmans, 6/-)

British Marine Engine History in Meccano

VI.—Modern Heavy Oil Engines

AS shown in last month's "*Meccano Magazine*," turbines have largely replaced reciprocating engines as the means of propelling ships. A serious competitor to both types of steam engines has now made its appearance, for recent years have seen the introduction and development of an entirely new type of marine motive power. This is the heavy oil engine, the pioneer of which was Dr. Rudolf Diesel, an engineer who was born in Paris and trained at the Munich Polytechnic. Early in his career Diesel was impressed by the low efficiency of the steam engine, and after experiments with an engine employing coal dust as fuel he took out in 1892 a patent for an engine utilising crude oil. Three years later he produced his first successful engine. Improvements followed rapidly, the original engine being greatly modified, and the Diesel engine in its various forms eventually became a formidable competitor of the steam turbine and reciprocating engine. Diesel disappeared at sea in 1913 while on a voyage to England, and his mysterious death prevented him from seeing the triumph ot the heavy oil engine.

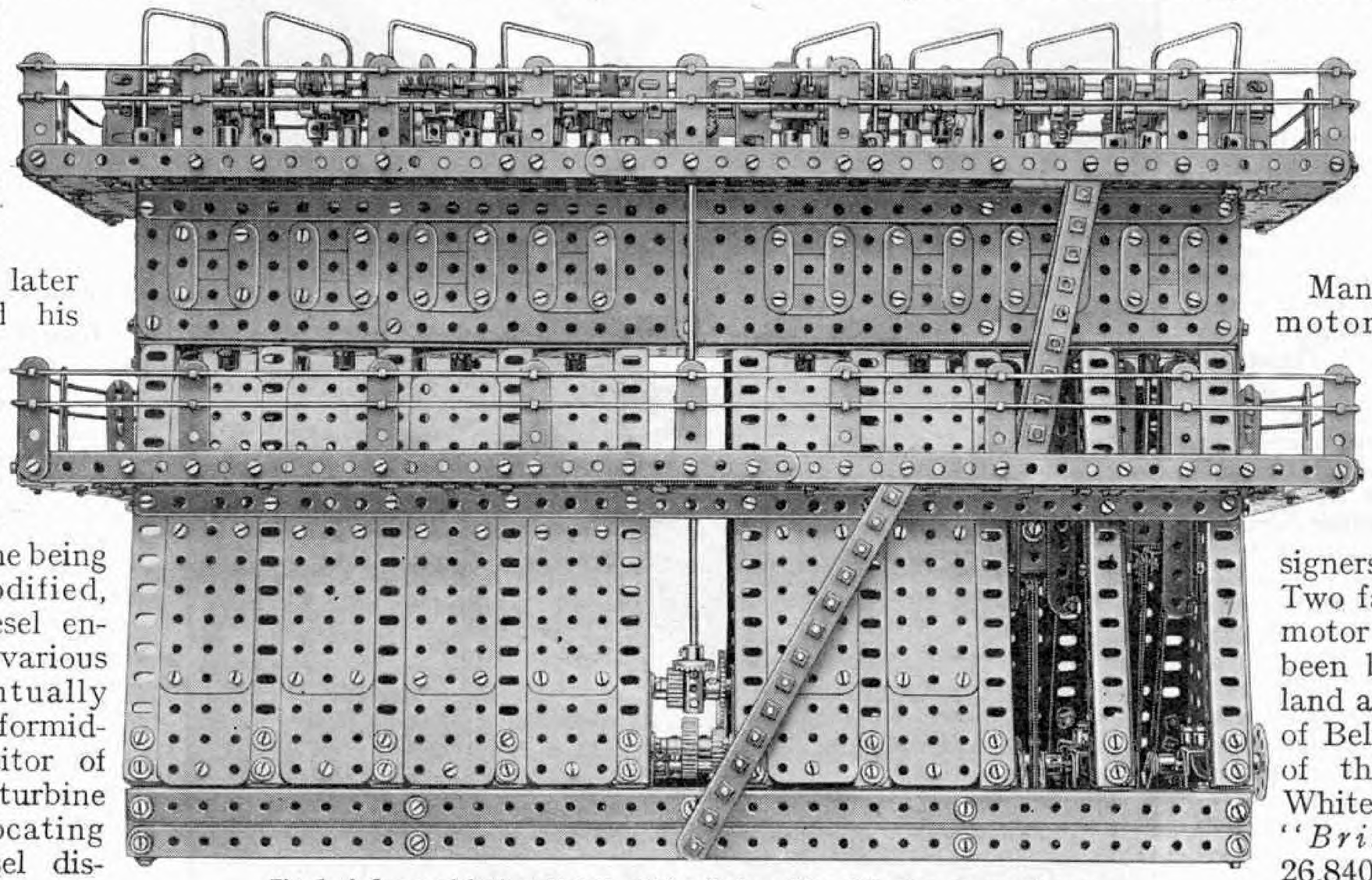


Fig. 1. A fine model of an M.A.N. eight cylinder, airless injection, heavy oil engine.

Early marine engines of the internal combustion type used different types of fuels, but it was soon realised that for general use the residue from refined petrol was the most advantageous. The fuel is now generally known as crude oil, and engines using it differ in many respects from internal combustion engines employing petrol. The chief difference is that the mixture injected into the cylinders is not ignited by means of an electric spark; instead its temperature is raised to ignition point by the heat developed during the compression stroke. The absence of an ignition system is one of the chief reasons for the popularity of the heavy oil engine and in addition the possibilities of fire are reduced to a minimum, since in normal circumstances, the fuel used is not inflammable.

Although the installation of a heavy oil engine in a ship is usually more costly than that of a steam engine, whether of the turbine or reciprocating type, the extra initial outlay is more than recovered in savings on running costs, for smaller engine room staffs are required, and other expenses are reduced. In addition less space has to be allotted to the fuel than would be needed in a steamship for coal or oil fuel, and a motor vessel therefore can be given a remarkably large cruising radius. This is of special value in the case of warships. Many remarkable voyages have been made of recent years by the German vessels, the light cruiser "*Karlsruhe*," and the pocket battleship, "*Deutschland*," both motor vessels, and the impression these warships have made is being shown by the interest taken in their performances in many maritime countries.

Many remarkable motor ships for mercantile purposes also have given great satisfaction to the designers and owners. Two famous British motor vessels have been built by Harland and Wolff Ltd. of Belfast. The first of these was the White Star liner, "*Britannic*," of 26,840 tons, the construction of which was closely followed by that of her sister ship, the 27,759 ton "*Georgic*." Both vessels have been running for several years on the regular trans-Atlantic service and also on pleasure cruises. They are exceptionally good sea boats, and have shown marked efficiency.

Heavy oil engines for ocean-going vessels have been developed so rapidly that it is difficult to follow the stages through which they have passed. The tendency has been in the direction of six or more cylinders, as many as 10 or 12 being commonly used for large vessels in which freedom from vibration is of major importance. A fine Meccano model of a multi-cylinder crude oil engine is illustrated in Figs. 1 and 2. This model is a scale reproduction of an M.A.N. eight cylinder airless injection, four stroke cycle engine, developing over 3,000 B.H.P. In an engine of this type the fuel from the main tanks is injected into the cylinders by means of a force pump. It passes through fine nozzles, and as it enters the cylinders is mixed with air passed through a separate valve and compressed by the piston until it reaches a high temperature. This is not in accordance with general

crude oil engine practice, the usual method being to force the fuel into the cylinder by compressed air. In the model the pipes taking the fuel from the control valves to the cylinder heads are seen above the valve gear.

The base of the model is constructed from 18½" Angle Girders and 4½" Angle Girders, Flat Girders being used as shown in order to give depth to the base. At the point where the long Girders forming the sides of the base are secured to the shorter Girders representing the ends, 1" Corner Brackets are used for strengthening purposes. At intervals of 2½" eight pairs of 4½" Angle Girders are fitted to carry the main crankshaft bearings.

As shown in Fig. 1, each bearing is represented by two 1½" Flat Girders and two Angle Girders of similar length, the Angle Girders being fitted with ½"×½" Angle Brackets and Collars in order to give the effect of a plumber block. The construction of the crankshaft is similar throughout its entire length to the portion shown in Fig. 1, the two side plates of the engine at this point being removed in order to show the internal construction. The space between the two centre bearings of the engine is fitted with a 1" Gear that meshes with a similar gear carried on a 2" Rod and journalled in two 1½" Flat Girders. The Rod carrying this second 1" Gear also supports a ¾" Pinion that is in engagement with a 50-teeth Gear mounted on a Rod and carried in bearings as shown. A second ¾" Pinion, driven by the 50-teeth Gear, drives a long vertical Rod that will be described later.

At similar intervals to those between the crankshaft bearings, 1"×1" Angle Brackets are fitted to the base at each side, and these support the main standards supporting the cylinder block. Each standard is composed of two 7½" Angle Girders fitted with a 4½"×2½" Flat Plate. This Plate carries two 4½" Angle Girders to form a channel in which slides one side of the corresponding crosshead, a Channel Bearing, and the standards must be secured rigidly to the 1"×1" Angle Brackets already mentioned, since they are unsupported at their upper ends. Each of the end pairs of standards is fitted with a 2½" Flat Girder by means of which the cylinder block is held in place.

The cylinder block is composed of a number of 5½"×2½" and 2½"×2½" Flat Plates that are held in place on a framework of 18½" and 2½" Angle Girders. The top of the cylinder block is not fitted until the valve gear is to be attached. The underside of this part of the model is fitted with eight Bush Wheels representing the bottom ends of the cylinders. Each of these forms a bearing for a piston rod, a 3½" Rod, and this is secured to its crosshead by means of a Coupling, the underside of the crosshead being secured to the connecting rod by a ⅜" Bolt, and two ½"×½" Angle Brackets. The lower end of the connecting rod is carried on a ¾" Bolt forming the connection between the two crank webs. Great care must be exercised in "lining up" the various bearings, especially the crankshaft bearings, for the connections between the crank webs are liable to work loose if these are not correctly fitted.

The general appearance and construction of the catwalks round the engine will be seen on reference to Figs. 1 and 2. The ladders communicating with these walks are constructed from Strips of suitable lengths and 1" Threaded Rods held in place by locknuts. Handrails are represented by lengths of Spring Cord held in place by Dredger Bucket Clips.

The valve gear is shown in detail in Fig. 2. The camshaft is journalled in the upper holes of six bearings formed from 1½" Angle Girders and Simple Bell Cranks. The cams are formed from Collars and Bolts and the timing of these for each cylinder must be carefully adjusted. The inlet valve, which is the first on the left of each cylinder head, opens as the piston descends during the inlet stroke. The valve then closes, and all three valves are closed as the piston ascends to effect compression and remain closed during the explosion stroke. The exhaust valve opens as the piston ascends for the exhaust stroke, and the scavenger valve, which is the middle one of the set of three, opens when the piston is halfway through this stroke.

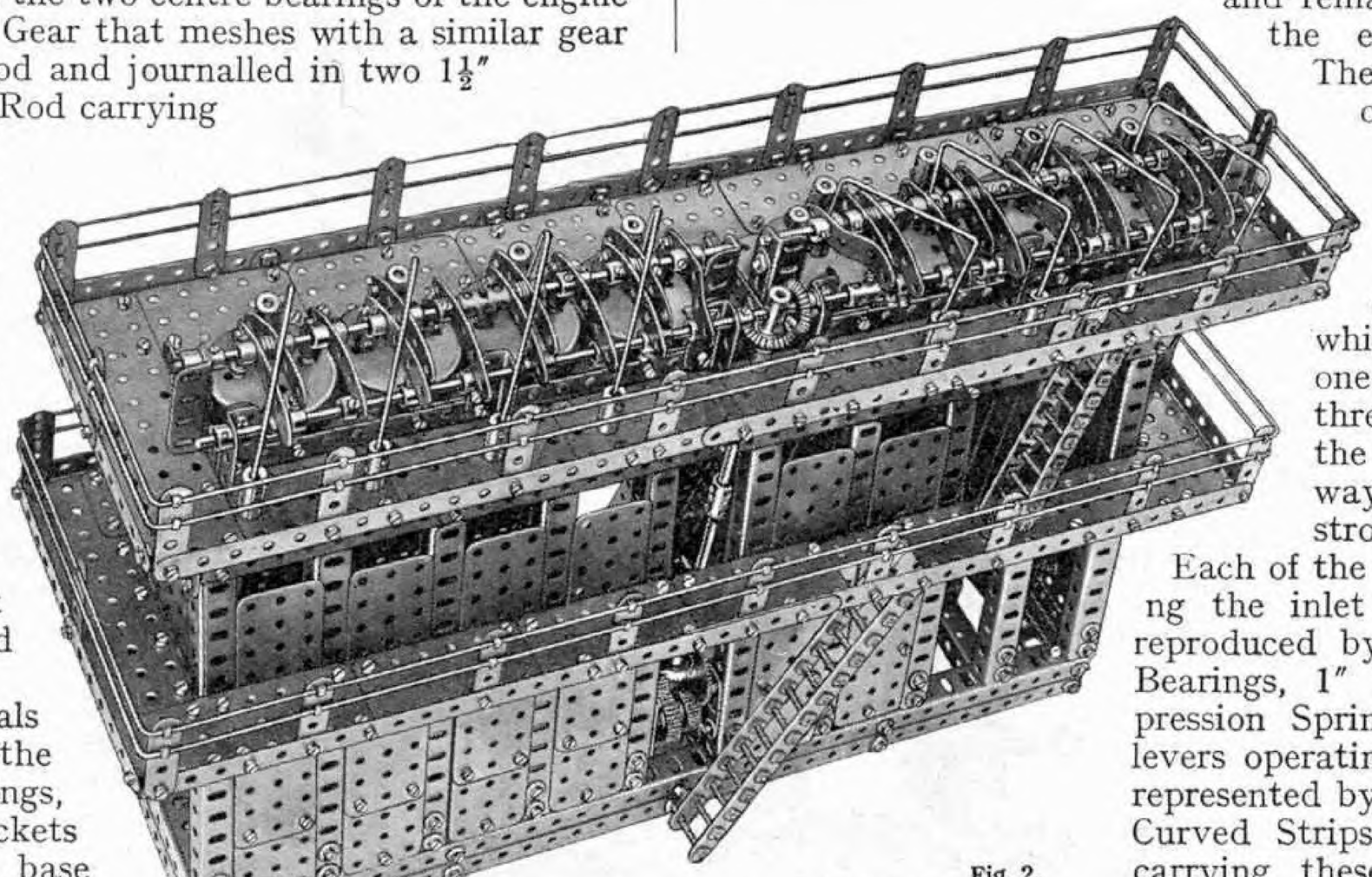


Fig. 2.
A view showing the valve-gear of the M.A.N. marine engine.

Each of the valves representing the inlet and exhaust is reproduced by means of End Bearings, 1" Rods and Compression Springs. The rocking levers operating the valves are represented by 2½" large radius Curved Strips, and the Rods carrying these are supported at each end in 2" Angle Girders. The injection pipes are shown in the illustration, from which the method of operating the camshaft will be gathered.

Among the modified and improved forms of heavy oil engines none have been quite so conspicuous as those introduced by William Doxford & Sons Ltd., whose works at Sunderland have produced some of the most remarkable heavy oil engines known. These engines employ two pistons in each cylinder that travel in opposite directions. They are coupled to the crankshaft by a system of three cranks per cylinder, the upper piston being coupled by two long connecting rods. Thus work is recovered that in an engine of normal type is lost owing to the expansion of the hot gases against the cylinder head. Water cooling is employed for the cylinder walls and the piston rod glands, the water being delivered to the upper piston rod by means of lengths of armoured hose.

The most recent Doxford engine has four cylinders arranged in separate pairs. It develops 3,300 I.H.P. when running at 92 r.p.m., and for its weight and size is a remarkably powerful and economic power unit. One of its most outstanding features is its comparatively small weight, for this has been reduced considerably by

the adoption of electrically-welded construction for the engine framings.

The Meccano model shown in Figs 3 and 4 is a scale reproduction of this remarkable unit, and embodies all the main characteristics of the prototype. The lower portion of the frame consists of a rectangular base built up from 18½" and 7½" Angle Girders, the vertical members being composed of 9½" Angle Girders. The plating of the sides and ends is accomplished by means of 5½"×3½" Flat Plates and other Plates of various sizes. Inspection covers are represented by Face Plates, those fitted to the upper set of removable side plates being detachable, together with the sections of the model to which they are fitted. A platform is constructed round the entire engine at the top of the 9½" vertical members already mentioned. It is built up of Flat Plates braced underneath by means of 5½" and 4½" Strips held in place by means of Angle Brackets.

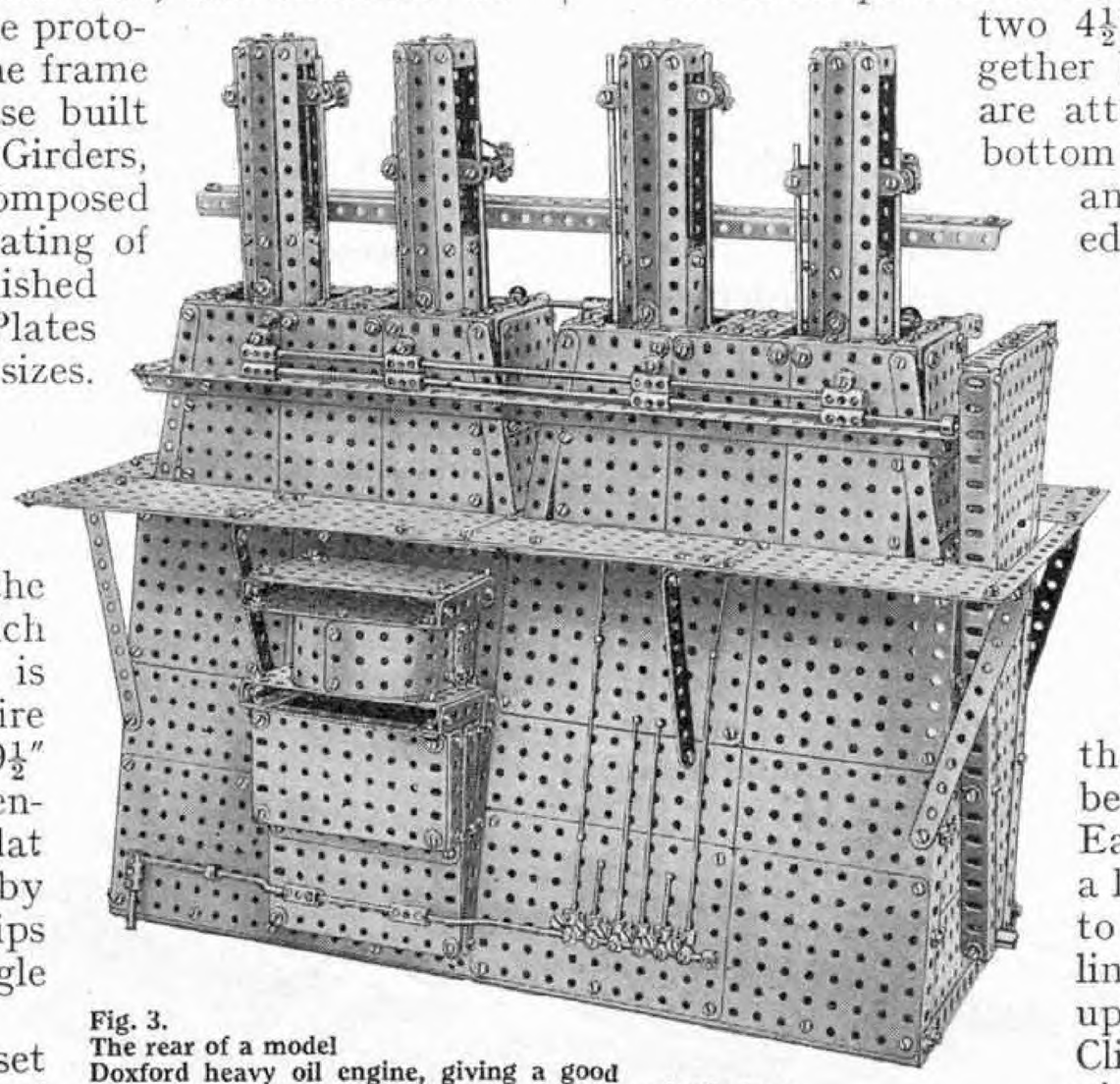


Fig. 3.
The rear of a model Doxford heavy oil engine, giving a good impression of the clean finish to an engine of this type.

Each pair of cylinders is set in a block secured to the top of the lower engine framework, as shown, and each cylinder is built up from 9½" and 5½" Strips bolted round the outside of 4½" Strips bent to the required shape. The two pistons in each cylinder slide in the bosses of Bush Wheels and are coupled up as shown by those sections of the engine framework that have been omitted. The main crankshaft bearings are built up from 2½"×2½" Flat Plates secured to 7½" Angle Girders and each is made sufficiently wide by spacing the two Plates used in its construction by means of Double Brackets.

The construction of the dummy valve gear on both sides of the engine is made clear in the two illustrations, and the drive for this gear is transmitted from a ¾" Sprocket Wheel on the crankshaft to two similar Sprockets, one on each side of the engine, by means of a length of Sprocket Chain that passes completely round the three Sprockets. The armoured hose directing the cooling water to the upper cylinders is represented by lengths of Spring Cord, the various fittings used in conjunction with this Spring Cord being constructed as shown.

The rear of the engine is fitted with a large pump, the movement of the piston of which is taken from one of the two centre sets of cross-heads by means of two 2" Strips carried on a 4½" Rod. This Rod is secured to the two outer cross-heads of that set by means of two Cranked Bent Strips. The 2" Strips are pivotally attached to two 5½" Strips that are carried on a 5" Rod and connected to the pump piston by a 4½" Rod.

The lower portion of the pump casing is built up from two 4½"×2½" Flat Plates held together by 4½" Angle Girders. These are attached to the model at the bottom by two ½"×½" Angle Brackets and the spaces between the edges of the Plates and the side of the engine are filled in by Strips of suitable length. The pump proper is set between inflow and outflow pipes, as illustrated, these in actual practice conveying the cooling water and air to and from the pump. A pipe consisting of a large Crank Handle and a small one and a 2½" Rod crosses the lower portion of the pump, a number of branches being taken from this as shown. Each branch is represented by a length of Spring Cord secured to the pipe by a Handrail Coupling and held in place at its upper end by a Dredger Bucket Clip. The various pieces of the pipe already mentioned are secured together by Couplings, these being attached to the engine by Set Screws.

The indicator panel is situated, for convenience, immediately above the control levers, the various small dials being represented by Bolts and Washers. One large dial at the bottom of the panel consists of a ½" loose Pulley. The panel is built up from two large Corner Brackets and a 2½" small radius Curved Strip, the edge of the complete fitting being composed of Strips of various lengths.

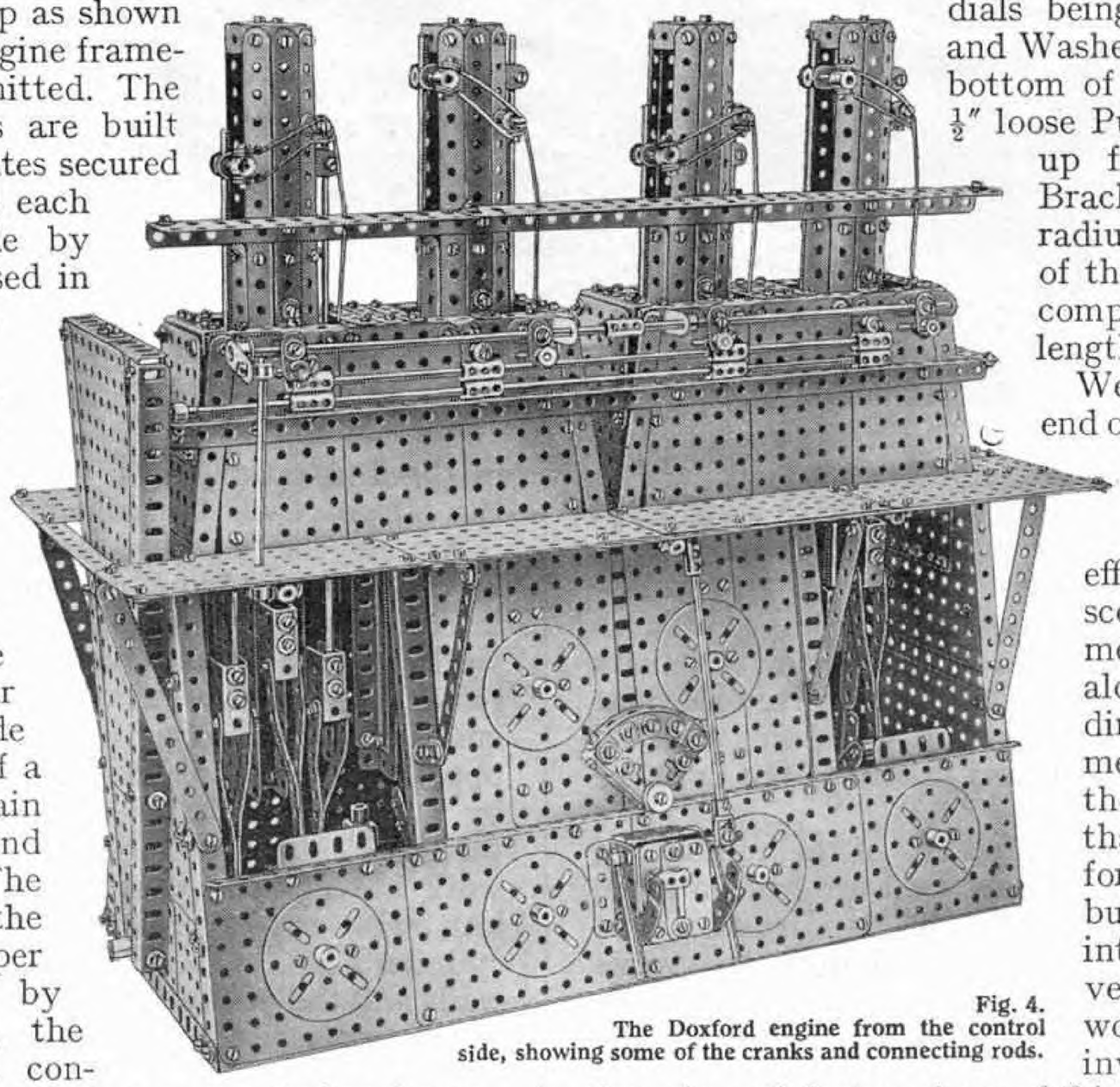


Fig. 4.
The Doxford engine from the control side, showing some of the cranks and connecting rods.

We have now come to the end of the story of the growth of the marine engine. Modern engines of all types are remarkably efficient, but there is still scope for much improvement and invention. Time alone will show in which direction further development will take place, but there seems little doubt that in a few years some form of internal combustion turbine will be introduced. Many inventors are now hard at work on the problems involved in the construction of a satisfactory form of this type of engine, in which the crankshaft will be given a continuous torque instead of being subjected to violent impulses at intervals, as in the ordinary type of internal combustion engine. Success in these efforts would greatly strengthen the position of the heavy oil engine.

Model-Building Competition Results

By Frank Hornby

"Christmas" Contest (Overseas)

The "Christmas" Model-Building Competition was announced in the December 1933 issue of the Magazine, and was open to competitors of all ages, the entries being grouped into separate Home and Overseas Sections. Competitors were free to submit models of any kind, and no restrictions were placed on the quantity of parts or size of Outfits to be used. As a result the entries cover an enormous range of subjects and include some very interesting models. The lists of prize-winners in the Home Sections were published in the June "*M.M.*," and this month we are able to announce the results in the Overseas Section of the Contest. The complete list of awards is as follows:

FIRST PRIZE, Meccano or Hornby Goods value £3-3s.: L. Suarez-Ynclan, Madrid, Spain. SECOND PRIZE, Goods value £2-2s.: W. Ryan, Melbourne, Australia. THIRD PRIZE, Goods value £1-1s.: A. Butcher, Canterbury, New Zealand.

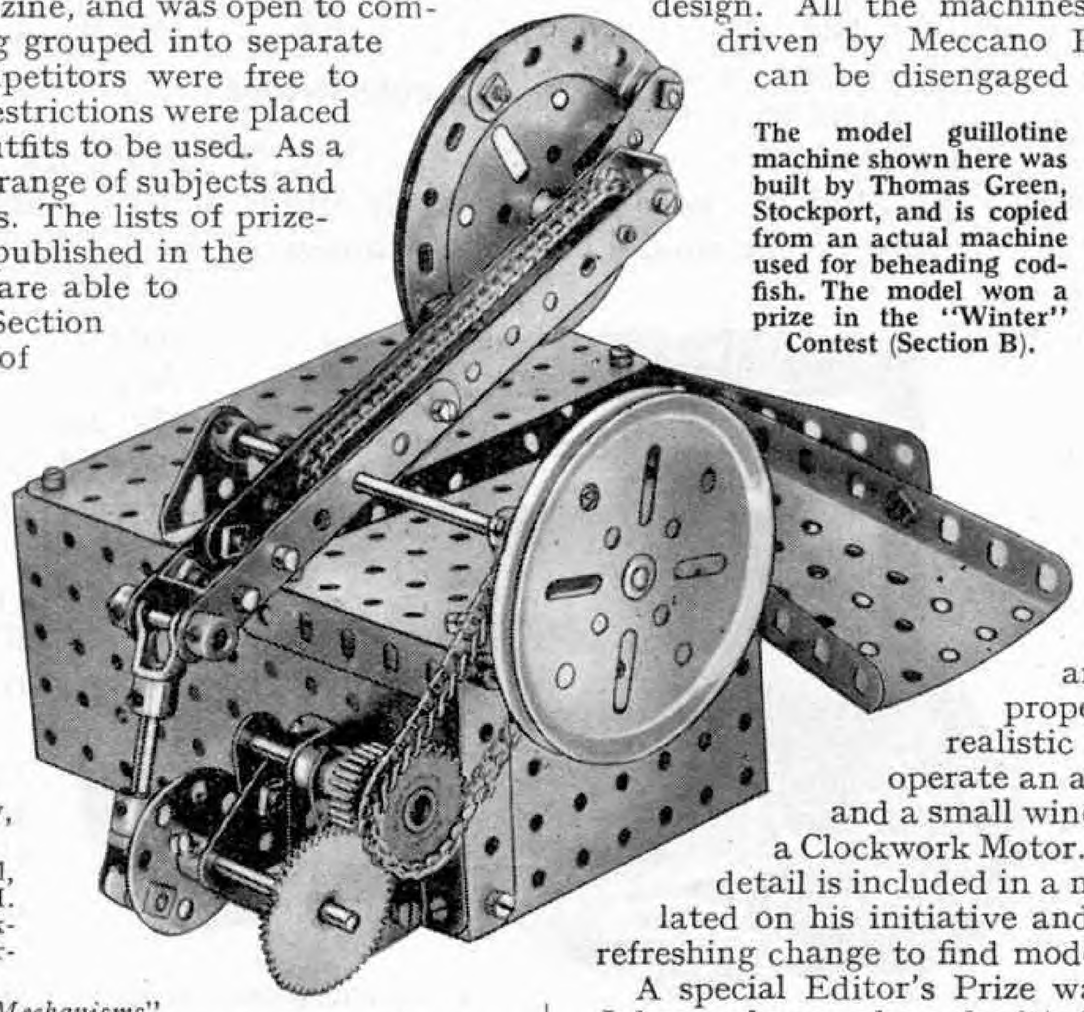
EDITOR'S SPECIAL PRIZE of Goods value £1-1s.: J. Pienaar, Johannesburg, South Africa.

FIVE PRIZES of Goods value 10/–: P. Giese, Buenos Aires; J. Collins, Melbourne, Australia; Casalicthio Bruno, Bologna, Italy; G. Alington and R. Alington (joint entry), Invercargill, New Zealand; G. Harvey, Levin, New Zealand.

FIVE PRIZES of Goods value 5/–: E. Rose, Natal, S. Africa; W. Jones, Winnipeg, Canada; H. Shorten, Regina, Canada; C. Akrell, Stockholm, Sweden; W. Nydegger, Bern, Switzerland.

TWELVE PRIZES of Meccano "*Standard Mechanisms*" Manuals: R. Parrott, Johannesburg; K. Caldwell, Brisbane; R. Doolen, Kyogle, N.S.W.; A. Johnstone, Piora, N.S.W.; D. Rankin, Melbourne; D. Brilliant, Montreal; A. Lewin, Toronto; E. Thomson, Gladys, Alberta; W. Scott, Montreal; S. Alley, Calcutta; N. Burt, Murchison, New Zealand; H. Stringfield, Morrinsville, New Zealand.

CERTIFICATES OF MERIT: R. Allan, St. Catharines, Canada; R. Kennedy, Christchurch, New Zealand; R. Lindsay, Winton, New Zealand; D. Teaze, Wellington, New Zealand; J. Ramirez, Alberdi, Argentina.



The model guillotine machine shown here was built by Thomas Green, Stockport, and is copied from an actual machine used for beheading cod-fish. The model won a prize in the "Winter" Contest (Section B).

I regret that I am unable to illustrate the First, Second, or Third Prize models as none of the photographs I have is suitable for reproduction.

One of the most surprising and pleasing features of this Contest is the success of a blind competitor in winning the First Prize. This remarkable young man's name is L. Suarez-Ynclan and he lives in Madrid. To be able to construct any sort of model while labouring under such difficulties is distinctly meritorious, but to build a model considered worthy of First Prize in a Meccano Contest is a truly fine achievement. I am sure all Meccano boys will join me in congratulating this Spanish competitor on his success.

Suarez-Ynclan's model is an electric derrick crane. The framework consists of a strong travelling base that runs on 16 Flanged Wheels, and a central tower or post, which is fitted with two fixed jibs, one on each side. The hoisting cords pass from the end of each jib round a single sheave pulley block on the hoisting cradle, and thence over a 3" Pulley at the jib head. From there they pass over a peculiarly arranged system of Pulley Wheels, which serves to increase the lifting power of the Meccano Electric Motor that supplies the driving power for the model.

The upper part of the model, which supports the jib, is fitted with a Roller Bearing so that it can be rotated with a minimum of power expenditure. The superstructure and the jibs are swivelled by the Motor, and an ingenious gear-box can be brought into operation to transmit the drive to the travelling wheels when it is desired to traverse the crane along the ground.

A model workshop, the construction of which necessitated several years' spare time work, secured the Second Prize for Mr. W. Ryan. Over 195 yards of Strips and Angle Girders are incorporated in the structure, and the whole is held together by 2,430 Nuts and Bolts. Some of the lathes, drills and other machines fitted in the model have been copied from the Meccano Instruction Manuals, but others are of entirely original design. All the machines take their power from lay-shafts driven by Meccano Electric Motors, and each machine can be disengaged from its respective layshaft when desired. The model is lighted throughout by electricity taken from the house electric mains, and an auxiliary lighting system is provided by 3-volt flash-lamp bulbs supplied with current from a mains transformer.

A. Butcher built a working model of a ship dredger, which is fitted with bucket and chain dredging equipment that can be set in motion by an Electric Motor concealed in the hull. The same Motor is used to drive the twin propellers with which the ship is fitted, and by means of a resistance controller the speed of the propellers can be governed in a very realistic manner. A second Motor is used to operate an anchor hoist in the bows of the vessel, and a small winch situated in the stem is powered by a Clockwork Motor. It is not often that so much working detail is included in a model, and Butcher is to be congratulated on his initiative and the originality of his ideas. It is a refreshing change to find models of this kind in Meccano Contests.

A special Editor's Prize was awarded to Mr. J. J. Pienaar of Johannesburg, who submitted the life-size model of a man, illustrated on this page. Although the model does not actually work, a great amount of very good constructional detail has been put into it, and in many parts such as the hands, arms and head, considerable ingenuity and skilful use of Meccano parts is displayed. Noticeably good work is shown also in the features, where Angle Girders built up in pyramid fashion form the nose, and two Tension Springs bolted in place on the face represent the lips.



This mechanical "man" was built by J. Pienaar, Johannesburg, and won a special prize in the "Christmas" Contest.

One of the neatest models received in the Contest is a whaling ship, built by an Australian boy, J. D. Collins of Melbourne. The hull of the model is approximately 3 ft. in length and is made almost entirely of $12\frac{1}{2}$" Strips, which are bolted to the Angle Girders and Strips that form the ribs and main framework. Simplicity of construction is a distinguishing feature of the model and this is particularly noticeable in the superstructure. A wireless cab composed of $3\frac{1}{2}" \times 2\frac{1}{2}"$ Flanged Plates and $2\frac{1}{2}" \times 2\frac{1}{2}"$ Flat Plates is situated behind the smoke stack, and a boiler and ladders give access from the forward well-deck to the bridge. On the bridge itself are fitted imitations of the instruments that form the usual equipment of a whaler, including a telescope and ship's telegraphs. The addition of two tall ventilator cowls, each composed of three Couplings and a Chimney Adapter, and four life-boats made of $2\frac{1}{2}"$ Strips complete this part of the model. A harpoon gun is fixed in the bows and use is made of a Pointer to represent the harpoon. The masts are made from Rods.

A splendid model of a Leyland "*Tiger*" omnibus was submitted as the combined effort of G. W. and R. H. Alington, Invercargill, New Zealand. In my opinion the best part of the model is the chassis, but I do not wish to infer that the bodywork is badly built, for this is not the case. The whole of the model is indeed a fine piece of work. The chassis unit includes a gear-box and the usual clutch and differential transmission to the rear axle, Ackermann steering gear, semi-eliptic front springs and underslung rear leaf springs.

P. Giese of Buenos Aires chose for his subject the Riachuelo Transporter Bridge that crosses the River Riachuelo, Argentine, near its junction with the River Plate. A description and illustrations of this bridge appeared in the July 1933 issue of the "*M.M.*"

New Meccano Models

Steam Roller—Bascule Bridge—Crane—Power Hack Saw

A MECCANO model is most fascinating when it works under its own power, carrying out its different operations just as its prototype does in actual practice. By a touch of a lever the model is set in motion, and by moving another lever it can be reversed at the will of the operator. The four new models illustrated are each powered by a Clockwork Motor incorporated in such a manner that it forms part of the structure of the model and thus serves some useful purpose besides providing the driving power.

Steam Roller

Fig. 1 shows a simple model steam roller incorporating a No. 2 Clockwork Motor. In this case the Motor is mounted vertically, and represents the boiler and firebox unit. Two Sector Plates are secured to it by means of reversed Angle Brackets and are also supported by a $3\frac{1}{2}$" Axle Rod that is passed through the Plates and through the side plates of the Motor. The Rod is retained in place by means of Spring Clips. The rear Axle is journalled in the Sector Plates and carries two 3" Pulley Wheels, forming the rear rollers, and the 1" Pulley 1 that is driven by means of a Rubber Band from a 1" Pulley on the Motor driving spindle.

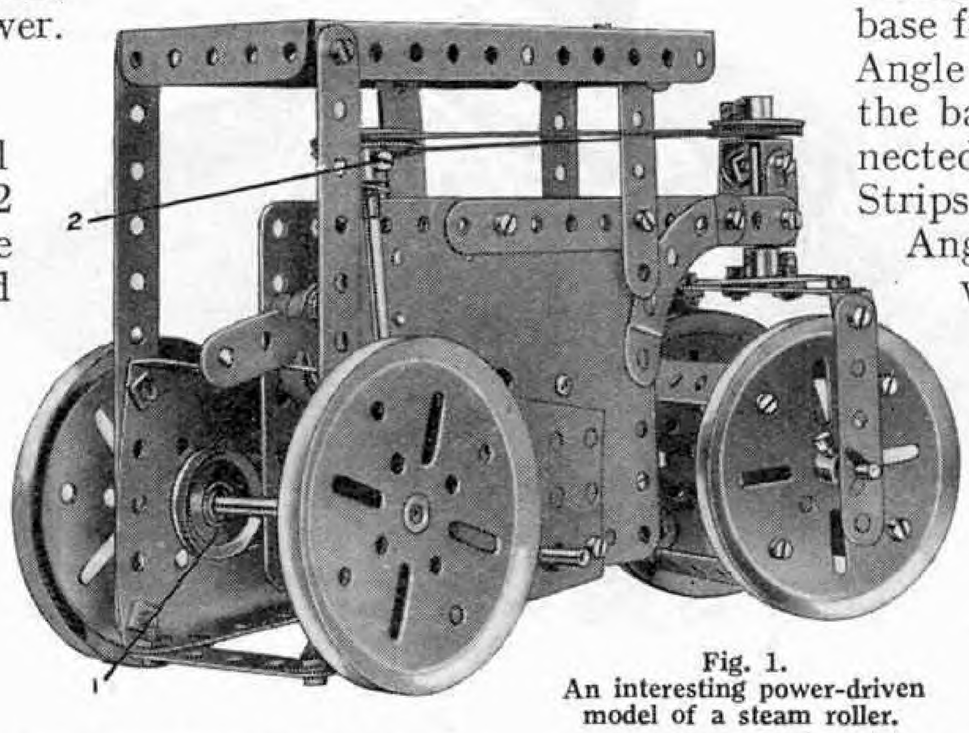


Fig. 1.
An interesting power-driven model of a steam roller.

Two $5\frac{1}{2}$" Strips extend the upper edges of the Motor plates and a Double Bracket is bolted between their ends, two Flat Brackets being held by the same securing bolts. A second Double Bracket is fixed between the upper ends of the Flat Brackets and a 2" Axle Rod is journalled in the centre holes of the Double Brackets. The lower end of the Rod is fitted with a Bush Wheel to which a $3\frac{1}{2}$" Strip is secured, and the upper end of the Rod carries a 1" Pulley. The $3\frac{1}{2}$" Strip carries an Angle Bracket at each end, and to these $2\frac{1}{2}$" Strips are bolted.

The front roller consists of two 3" Pulleys between which $2\frac{1}{2}$"$\times\frac{1}{2}$" Double Angle Strips are bolted. Steering is effected by turning the Pulley Wheel 2 that is connected by cord to the front Pulley. The cord is given a complete turn round each wheel. To complete the model the canopy is added. A $5\frac{1}{2}$"$\times 2\frac{1}{2}$" Flanged Plate is used for this, and is supported at the front by $2\frac{1}{2}$" Strips bolted to the Motor, and at the rear by $5\frac{1}{2}$" Strips attached to the Sector Plates.

Parts required for Steam Roller: 4 of No. 2; 1 of No. 3; 5 of No. 5; 3 of No. 10; 2 of No. 11; 3 of No. 12; 3 of No. 16; 2 of No. 17; 2 of No. 18a; 4 of No. 19b; 3 of No. 22; 1 of No. 24; 7 of No. 35; 36 of No. 37; 3 of No. 37a; 7 of No. 38; 1 of No. 40; 1 of No. 48; 4 of No. 48a; 1 of No. 52; 2 of No. 54; 2 of No. 90a; 3 of No. 111c; 2 of No. 125; 1 No. 2 Clockwork Motor and 1 Rubber Band.

Bascule Bridge

The No. 2 Clockwork Motor raises and lowers the bascule and is fitted in such a position that it strengthens the framework and forms a counterbalance weight, in addition to providing the power. The base for the bridge consists of two $12\frac{1}{2}$" Angle Girders that form rails on which the bascule rolls. The Girders are connected together at their ends by $3\frac{1}{2}$" Strips, and carry four $2\frac{1}{2}$"$\times\frac{1}{2}$" Double Angle Strips that support a framework of Braced Girders and a Flanged Plate. This structure represents the control room.

The bascule is made up of $12\frac{1}{2}$" Angle Girders with two Braced Girders bolted between them, and the sides are formed from Strips. A pair of $12\frac{1}{2}$" Strips are curved to form the segments on which the bascule rolls, and to prevent these from sliding on the rails, lengths of cord are tied to the ends of each and passed underneath, to be tied to the ends of the rails. The pairs of cords cross where the segments touch the rails, and as they are arranged in opposition the segments are prevented from sliding.

The Motor is placed so that the winding spindle projects above and the driving shaft below. A 1" Pulley is carried on the driving shaft, and cord is tied to the Set Screw, so that as the spindle rotates it is wound on. The arrangement of the cord can be seen in Fig. 2. It is passed over a 1" fast Pulley on a Rod journalled in the bascule and then round a 1" loose Pulley on a $3\frac{1}{2}$" Rod fixed between 1"$\times$1" Angle Brackets at the front of the control room. The cord is then passed round a loose Pulley on the bascule, round another Pulley in front of the control room, and finally tied to a Flat Bracket as shown.

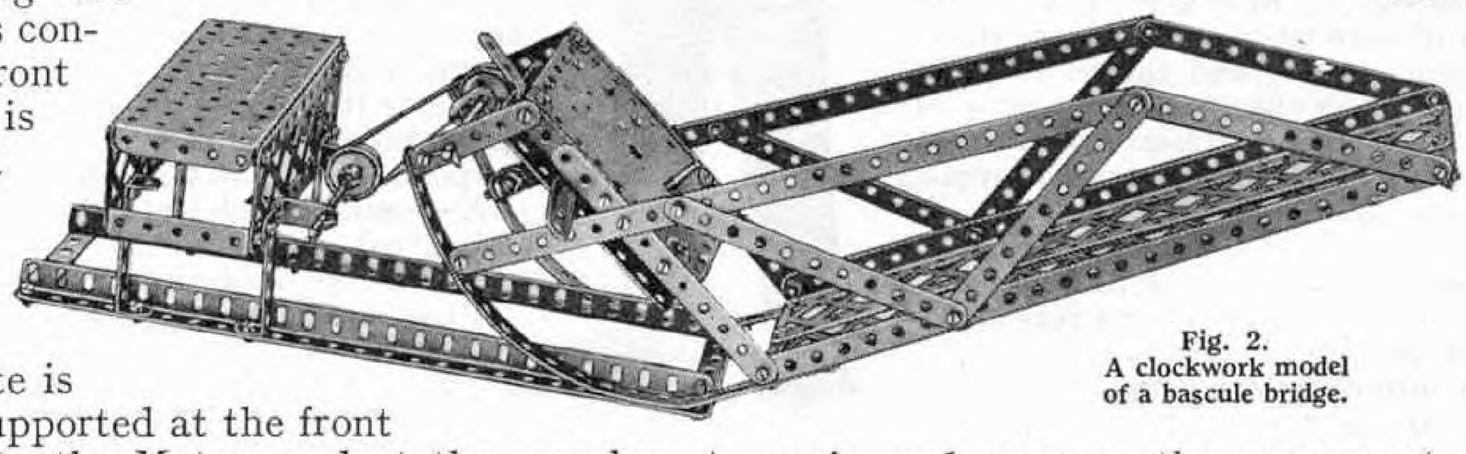


Fig. 2.
A clockwork model of a bascule bridge.

As soon as the Motor raises the bridge the brake must be applied, but for the lowering operation the Motor may be kept running so that after the cord is wound off the winding drum it rewinds again and reverses the movement of the bridge automatically.

Parts required for Bascule Bridge: 4 of No. 1; 8 of No. 2; 2 of No. 3; 4 of No. 5; 4 of No. 8; 1 of No. 10; 8 of No. 12; 2 of No. 12a; 1 of No. 15a; 1 of No. 16; 3 of No. 22; 2 of No. 22a; 7 of No. 35; 60 of No. 37; 2 of No. 38;

1 of No. 40; 6 of No. 48a; 1 of No. 52; 2 of No. 99; 2 of No. 100 and 1 No. 2 Clockwork Motor.

Pontoon Crane

The pontoon crane shown in Fig. 3 is provided with hand-operated slewing movement and power-driven hoisting movement. The base, which in this case represents the pontoon, is made of 12½" Angle Girders connected across the ends by 5½" Braced Girders and with two Sector Plates arranged longitudinally as shown. There is a space between the two Plates to admit the boss of the lower 3" Pulley Wheel that is bolted in position. The upper Pulley is provided with a 1½" Axle Rod that passes through the lower Pulley and carries a 1" fixed Pulley. Four Angle Brackets secure the Clockwork Motor to the upper 3" Pulley, and a length of cord passed round the Pulley is passed round a 1" Pulley on a short Rod journalled in one of the Braced Girders and a Double Bent Strip. A Crank, fitted with a Threaded Pin, is also attached to the Rod.

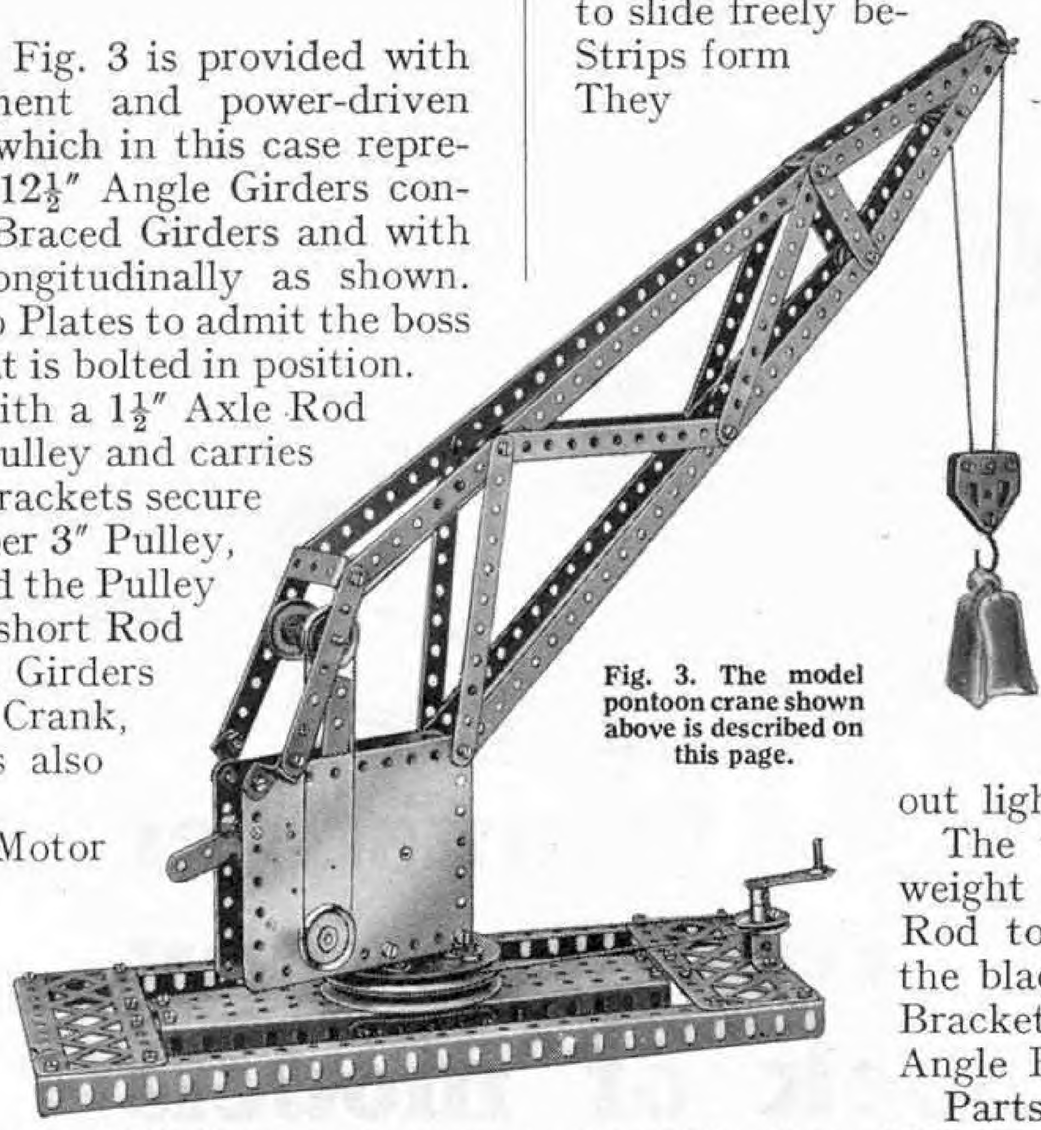


Fig. 3. The model pontoon crane shown above is described on this page.

It will be observed that the Motor is bolted in such a position that it helps to balance the weight of the jib, which is built up from Strips, and suitably braced to give extra strength. A belt drive from the Motor spindle is taken through 1" Pulleys and cord to a 2" Rod carrying two 1" Pulleys, between which the hoisting cord is wound on to the Rod. The cord passes over a 1" loose Pulley at the jib head, through a single sheave pulley block, and is then tied to a Double Bracket secured to the jib.

Parts required for Pontoon Crane: 4 of No. 1; 10 of No. 2; 2 of No. 3; 8 of No. 5; 2 of No. 8; 3 of No. 11; 4 of No. 12; 1 of No. 17; 3 of No. 18a; 2 of No. 19b; 4 of No. 22; 1 of No. 22a; 1 of No. 23; 1 of No. 24; 5 of No. 35; 50 of No. 37; 15 of No. 37a; 12 of No. 38; 1 of No. 40; 1 of No. 45; 1 of No. 48; 2 of No. 54; 1 of No. 57; 1 of No. 62; 2 of No. 100; 6 of No. 111a; 1 of No. 115; 2 of No. 125; 2 of No. 126a and 1 No. 2 Clockwork Motor.

Power Hack Saw

This interesting model closely follows the design of the large power hack saws to be found in many engineering workshops. The base of the model (see Fig. 4) is made of 12½" Angle Girders with 5½" Strips bolted between them. At one end is a 5½" × 2½" Flanged Plate, and at the other end the No. 1 Clockwork Motor is secured by means of Angle Brackets.

The Motor driving spindle 4 carries a Bush Wheel and a 3" Pulley that serves as a flywheel. The 5½" Strip 2 is passed over the Rod 4, and the Bush Wheel holds it in position against the Motor side plate. The Strip is free to pivot about the Rod, and to prevent undue side play a 2½" Strip 5 is bolted to the Motor but spaced by a Washer on each securing bolt to allow for the thickness of the Strip.

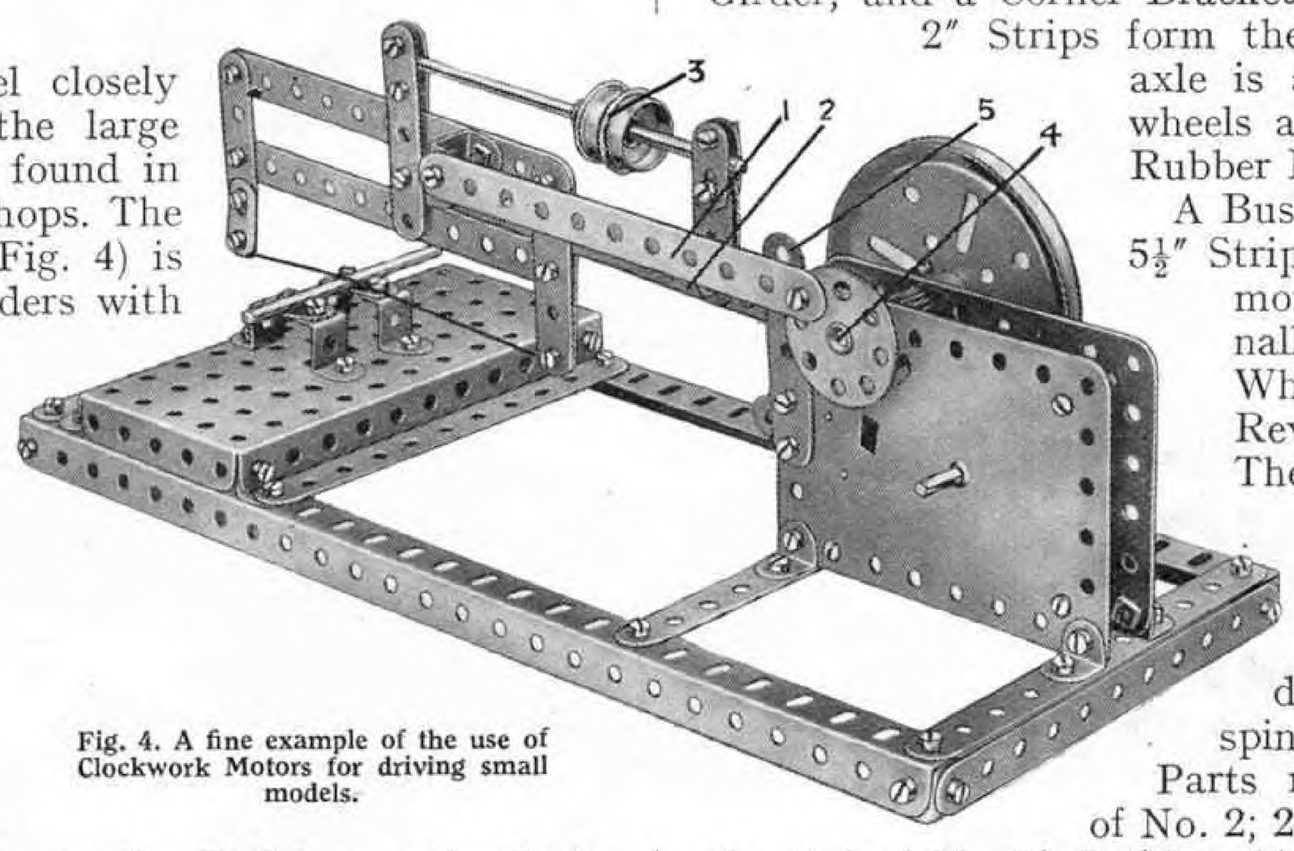


Fig. 4. A fine example of the use of Clockwork Motors for driving small models.

At the forward end the Strip is extended by Flat Brackets to which two 2½" Strips are fixed at right angles and spaced apart to permit the 5½" Strips shown to slide freely between them. These two 5½" Strips form part of the hack saw frame. They are connected across the outer ends by a 2½" Strip, and two Strips are bolted across their inner ends, one on each side of the Strip 2 on which the frame slides. The Strip 1 is pivotally attached to the Bush Wheel on the Motor shaft and also to a Double Bracket fixed to the saw frame. Thus, as the Bush Wheel rotates, the frame moves to and fro, and a fret saw or broken hack saw blade may be fitted in position as shown to carry out light sawing work.

The two Flanged Wheels 3 form a weight that can be moved along the Rod to vary the pressure applied to the blade. The work rests on two Flat Brackets secured between ½" Reversed Angle Brackets.

Parts required for Power Hack Saw: 11 of No. 2; 7 of No. 5; 2 of No. 6a; 2 of No. 8; 7 of No. 10; 1 of No. 11; 12 of No. 12; 1 of No. 15; 1 of No. 19a; 2 of No. 20b; 1 of No. 24; 53 of No. 37; 6 of No. 37a; 9 of No. 38; 1 of No. 40; 1 of No. 52; 4 of No. 111a; 4 of No. 125; and 1 No. 1 Clockwork Motor.

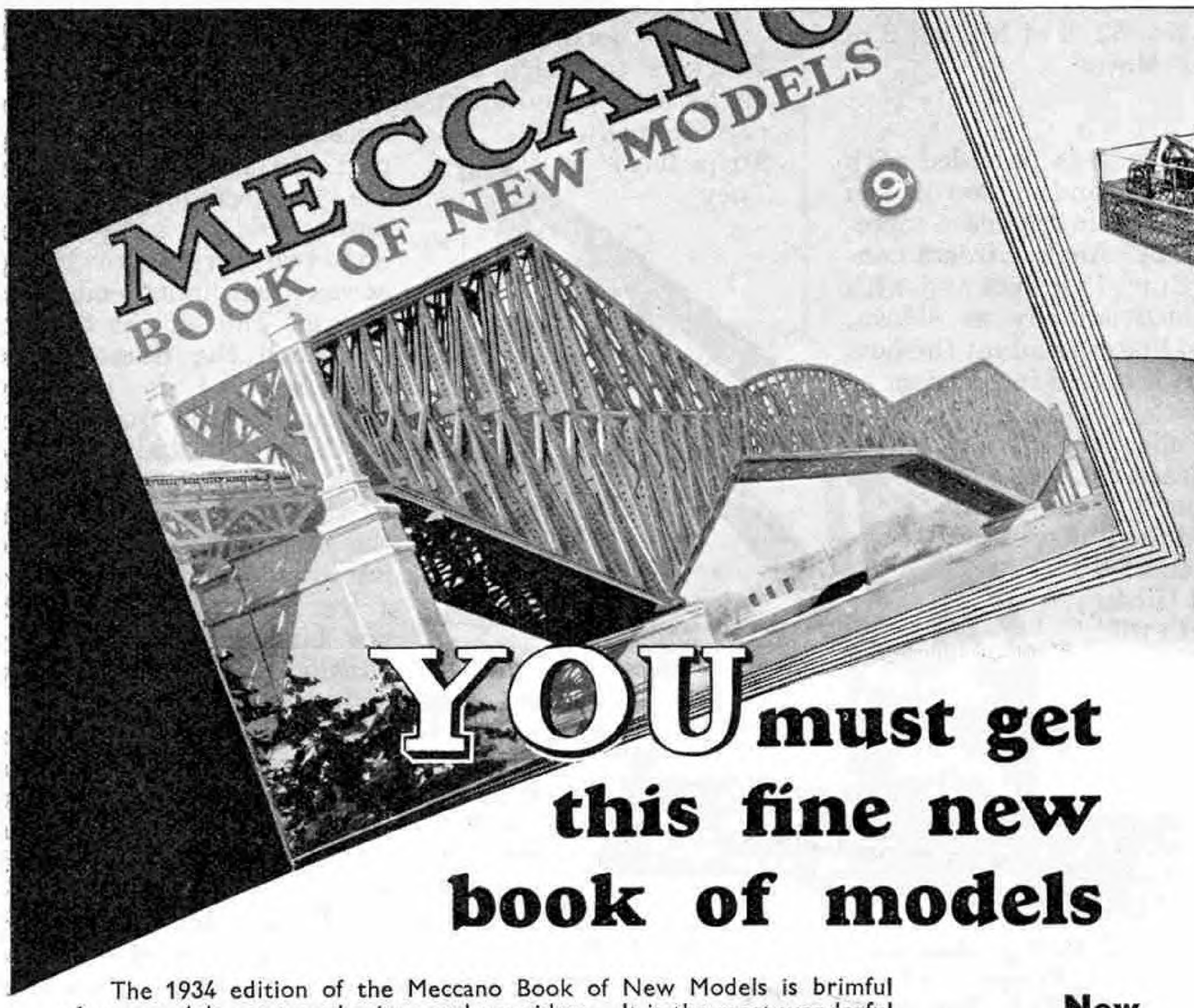
Autogiro

This model, not illustrated, will appeal to model-builders because of its neatness and realism, although it is not driven by a Clockwork Motor.

The fuselage is made from two 9½" Flat Girders spaced in the centre by a 1½" × ½" Double Angle Strip and joined at one end by a Double Bracket. The tail is built up from three 2½" × ½" Double Angle Strips and a 1½" Angle Girder, and a Corner Bracket represents the fin. Four 2" Strips form the undercarriage, and the axle is a 2½" Rod. The landing wheels are 1" Pulleys fitted with Rubber Rings.

A Bush Wheel fitted with three 5½" Strips forms the rotor, and is mounted on a 3½" Rod journalled in the boss of a Bush Wheel supported on four 1" Reversed Angle Brackets. The Rod is also held in a Coupling on the axle and is driven through two ⅞" Bevels. The propeller shaft is a 2" Rod, driven from the rotor spindle.

Parts required for Autogiro: 3 of No. 2; 2 of No. 3; 1 of No. 5; 4 of No. 6; 1 of No. 9f; 2 of No. 11; 1 of No. 12; 1 of No. 16; 1 of No. 16a; 1 of No. 17; 2 of No. 22; 2 of No. 24; 1 of No. 26; 1 of No. 28; 2 of No. 30; 40 of No. 37; 5 of No. 38; 5 of No. 48; 3 of No. 48a; 4 of No. 59; 2 of No. 63; 2 of No. 103a; 4 of No. 124; 1 of No. 133; 1 of No. 147a; 1 of No. 147b; 1 of No. 155; 1 of No. P199.



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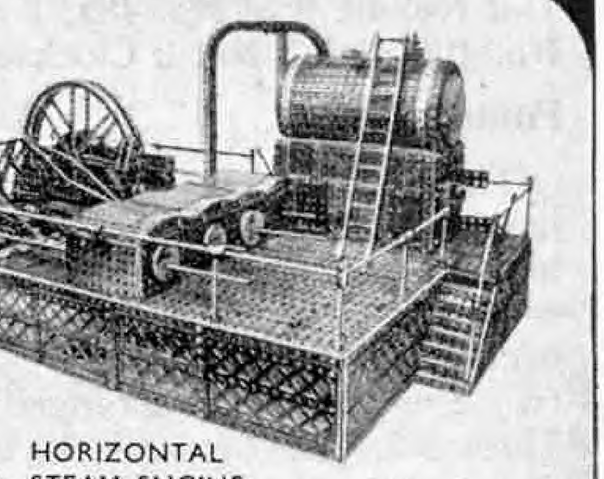
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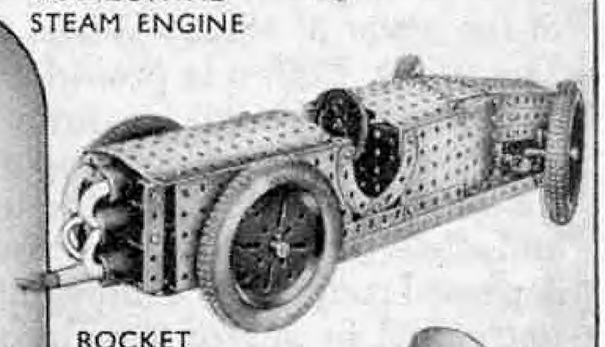
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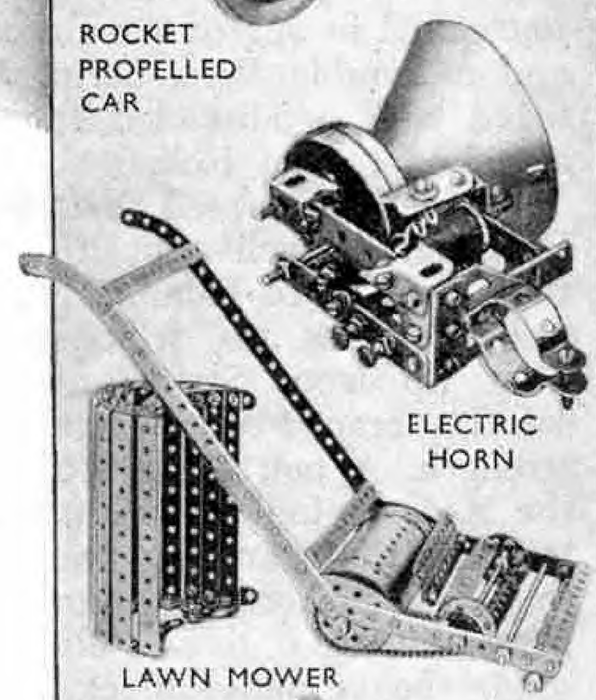
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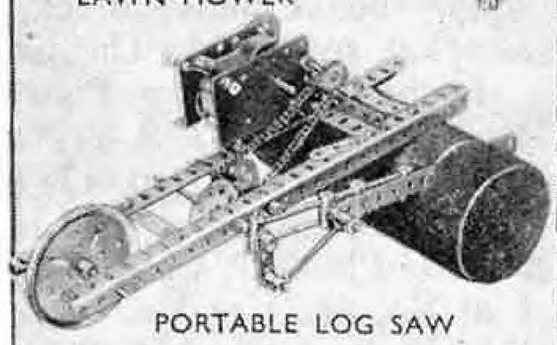
New Ideas

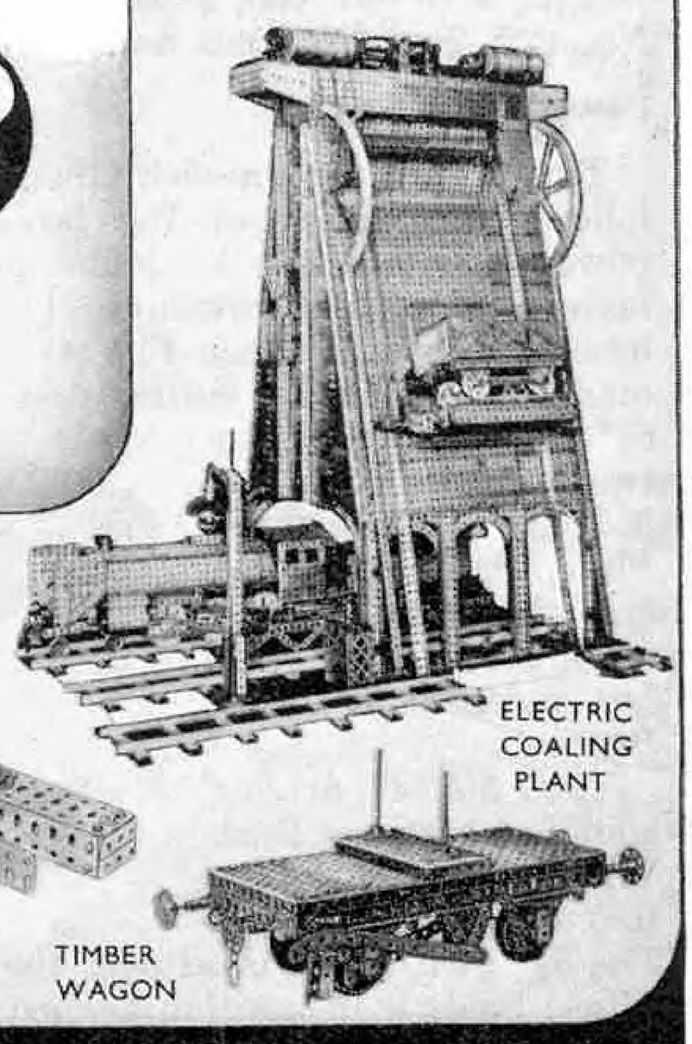
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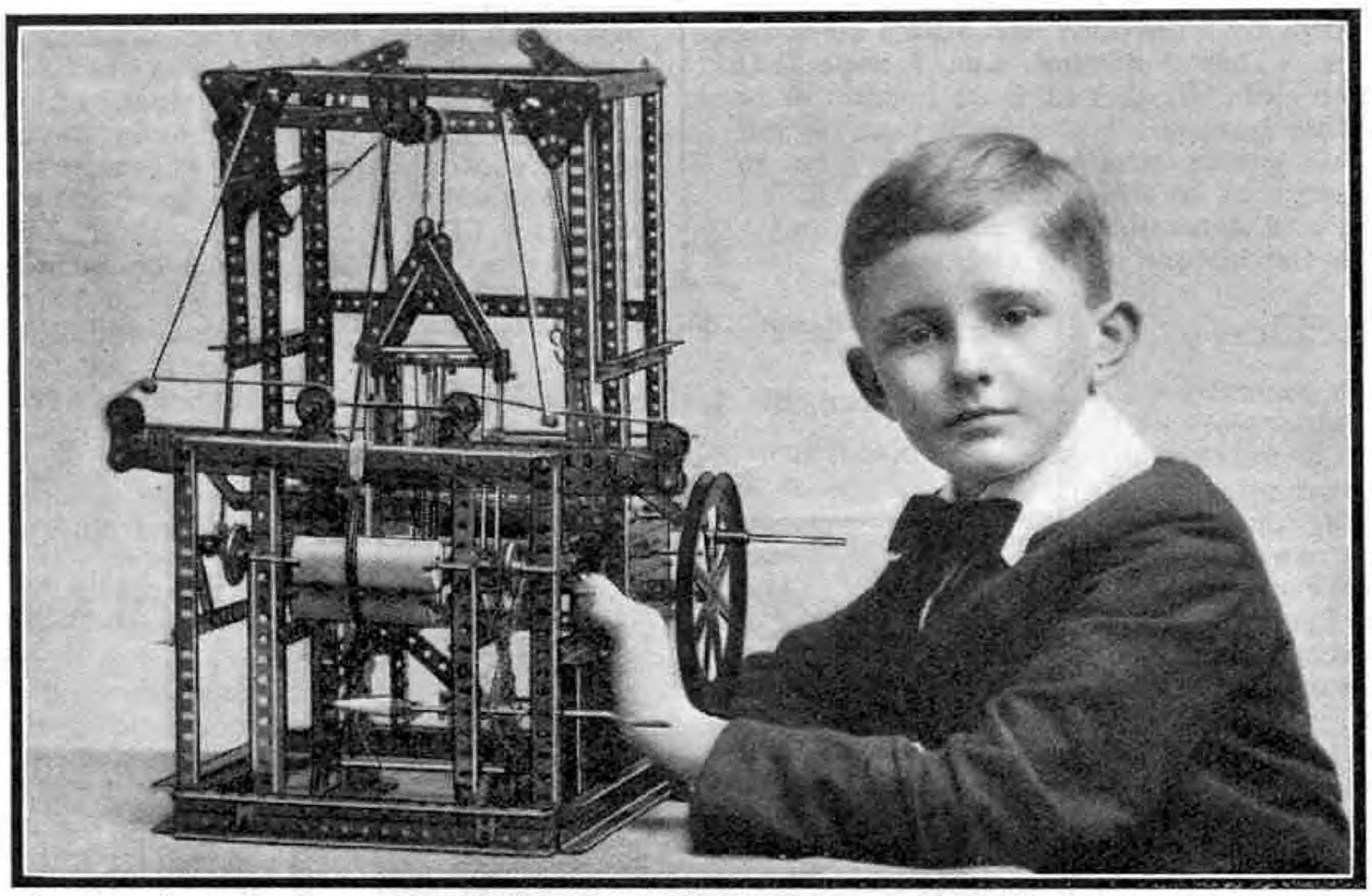
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Another Novel Summer Contest

Meccano "Resemblances" Competition

This month we have pleasure in announcing another novel summer competition. There is no model-building whatever to do, so that "*M.M.*" readers who are on holiday at the seaside or in the country can prepare and send in their entries just as easily as if they were at home. All a competitor requires are an illustrated price list of Meccano parts, a pencil, a sheet of paper, and last and most important, a vivid imagination! Illustrated price lists of Meccano parts can be obtained from local Meccano dealers.

Meccano users have no doubt noticed quaint resemblances between some of the Meccano parts and familiar everyday objects. For example, Part No. 128, Boss Bell Crank, when viewed from certain angles reminds one of a pterodactyl which, as readers probably will know, was a fierce prehistoric winged reptile; and it does not require much stretching of the imagination to discern a likeness to a gentleman's tall silk hat in the Ship's Funnel (Part No. 138).



A neat specimen of a Meccano Loom built by George Wood, Worcester. The builder is here shown preparing his model for work.

In entering this month's Contest competitors are asked to exercise their imagination in discovering other resemblances of this kind among the complete range of Meccano parts, and the examples we have mentioned will give an idea of what is required. The competition offers plenty of scope for ingenuity, and having spent some time in studying the Meccano parts list we can assure readers that we found it a quite amusing pastime.

The judges will award the prizes listed in the panel on this page to those competitors who succeed in finding the greatest number of "resemblances." It must not be thought, however, that the competitor who sends in the longest list will automatically receive the biggest prize; special attention will be given to the novelty of a competitor's ideas, and a list that is ingenious and novel in character will stand a good chance of winning the First Prize, even though the total number of resemblances it contains is not the largest submitted.

It should be noted that some of the Meccano parts present a different appearance when viewed from various positions. Competitors will be wise, therefore, to study the parts from all angles, as in this way it is possible that several "resemblances" for the same part may be discovered.

Competitors should prepare their lists in tabulated form, that is, the catalogue number and the name of the Meccano part should first be set down, and then opposite each item the competitor should state what he thinks the part resembles, as follows: Part No. 128—Boss Bell Crank—Pterodactyl; Part No. 138—Ships' Funnel—Tall Hat.

Entries should be prepared as neatly as possible and each sheet of paper must bear the competitor's name and address, which should be written in block letters.

Any boy with a keen imagination should be able to "spot" dozens of quaint and amusing likenesses among the Meccano parts, and in addition to the fun obtained in preparing his list, he has an opportunity to win a handsome prize.

The Competition will be divided into two Sections as follows: Section A for competitors of all ages living in the British Isles, and Section B, for competitors of all ages living overseas. A separate and complete set of prizes will be awarded in each Section. Details of the prizes are given in the panel on this page.

Entries for Section A must be posted so as to reach this office not later than 29th September, 1934. The closing date for Section B is extended until 30th November, 1934, in order to give Overseas competitors in distant countries plenty of time to forward their entries. Any entries received after the dates mentioned will be disqualified. Entries should be addressed to Meccano "Resemblances" Competition, Meccano Limited, Binns Road, Liverpool 13.

Prizewinners will be notified by letter as soon as possible after the closing date, and they will be allowed to select any articles they like from current Meccano and Hornby Train catalogues. Every reader of this month's "*M.M.*", irrespective of sex or age, is eligible for the competition, and we hope that everyone will take advantage of this holiday opportunity to win a prize.

In conclusion we would remind readers of the importance of stating their name and address, as omission of these has occasionally caused promising entries to be disregarded.

Prizes for "M.M." Readers

A separate and complete set of prizes as listed below will be awarded to successful competitors in each Section of the Meccano "Resemblances" Contest, full details of which are announced on this page.

First Prize, Meccano or Hornby Goods value £2-2s.
Second Prize, Meccano or Hornby Goods value £1-1s.
Third Prize, Meccano or Hornby Goods value 10/6.
Six Prizes of Meccano or Hornby Goods value 5/-.
Twelve Consolation Awards of Goods value 2/6.



The Holiday Month

Although there is no " close season " for Meccano clubs, August is a month of comparatively little activity, especially in the club room, for then many members are on holiday and others are more interested in outdoor work. This is natural, and I hope that every member of a Meccano club, whether he is on holiday or at home, is thoroughly enjoying himself. I also hope that he will benefit from the sports and games, whatever they may be, in which he is taking part, and that he will return to club life full of vigour and enthusiasm, and determined to make the coming winter sessions the best in the history of his club.

Thoughts for Leaders

Leaders and club officials generally will soon be making plans for indoor work and deciding upon the policy to be followed in order to make their clubs more prosperous than ever. In doing so the aims of the Guild should be kept clearly in view. The first of these is to make every boy's life brighter and happier. All Leaders realise the need for arranging pleasant meetings of all kinds in order to ensure jolly times for their members, and in return for their unselfish efforts to fulfil this aim they earn the confidence of their members and, in the words of one of the most successful of them, come to realise " what a dull sort of world it would be without boys."

Attention to the friendly and social side of a club lays the foundation for successful pursuit of the other aims of the Guild, particularly the second, which is to foster clean-mindedness, truthfulness, ambition and initiative in boys. Success in the third aim—the development of their knowledge of mechanical and engineering principles, and general encouragement of members in their studies and hobbies—also depends on the existence of confidence between members and officials.

During the coming winter sessions I should like to see this confidence developed even further by means of co-operative efforts of all kinds. Any tendency on the part of members to work together should be encouraged to the utmost. For instance, ample facilities and assistance of every possible kind should be given to groups of members who wish to pool their resources in order to embark on ambitious model-building operations. Carrying out a scheme of this kind usually is more helpful in developing skill and resource than building a series of unrelated small models, and the results give greater satisfaction.

Work of this kind can be made to lead up to concerted model-building schemes for club purposes, and I scarcely need emphasise the value of these in view of the many admirable dock scenes, fairgrounds and similar joint displays that form the central features of so many of the club exhibitions referred to in " *Club Notes.*"

Co-operation of this kind need not be confined to model-building, or indeed to the usual pursuits of clubs. I am convinced that boys thoroughly enjoy working together as a team for good objects with which they are in sympathy. This is shown by the eagerness with which displays in connection with efforts in aid of local hospitals have been arranged by several clubs. Members' pride in model-building skill is doubled when this is exercised in a worthy cause.

Meccano Club Leaders

No. 75. Mr. J. Coutts



Mr. J. Coutts is Leader of the Marlborough (Mont Albert) M.C., Victoria, Australia. This club was affiliated in February 1933, and Mr. Coutts has directed its fortunes since its formation. Its splendid progress has been due to a skilfully varied programme of Model-building, Lectures and excursions that has constantly stimulated the enthusiasm of members.

Competitions in Club Programmes

While encouraging co-operation of the kind I am advocating, ample opportunities should be given to members for the friendly rivalry in which they revel. Contests in which they are pitted against each other have always been favourite devices of Leaders for the encouragement of originality and the development of skill. They are of wonderful value in developing the initiative and resource of members, and the reports of Model-building Competitions and other contests organised by clubs that appear regularly in the " *Club Notes* " page show how varied and interesting these can be. They should be included in the programme of every club, and the ideal scheme is to combine internal rivalry with co-operation in advancing the interests of the club. I am sure that all clubs will have a very successful winter if these two aims are kept carefully in mind by Leaders, and the programmes are planned in accordance with them.

Films and Lantern Lectures

Lantern lectures and the exhibition of cinematograph films provide very effective means of giving variety to club programmes. Attractive films and sets of splendid lantern slides dealing with railways and industrial operations are now available, and these have real entertainment value, and give useful information on subjects of widely varying interest. I shall be glad to send a revised copy of the list of lectures and films of this kind prepared for the use of Meccano clubs to any Leader or secretary who writes for it.

For the benefit of the officials of clubs in which Lantern Lectures and film displays have not so far been included in the programmes, I should like to point out that this list gives the names of firms and railway companies willing to loan films or lantern slides for exhibition. It also explains the conditions attached to the loan. Usually the only expense to be incurred is the cost of return carriage, and every club possessing the necessary projector or having facilities for hiring or borrowing one should try to arrange for the loan of at least one of these lectures during each session. Many enterprising clubs have included Lantern Lectures or Cinematograph Displays among the attractions of their Exhibitions, and have reaped ample reward for their foresight.

Proposed Clubs

Attempts are being made to form Meccano Clubs in the following places, and boys interested should communicate with the promoters, whose names and addresses are given below :

AUSTRALIA—W. Simon, 21, Woodside Avenue, Lindfield, N.S.W.
BIRMINGHAM—E. L. Fenner, 58, Thimblemill Road, Bearwood.
HANWORTH—R. Vere, " Lynton," Queensway, Hanworth, Middx.
LONDON—Mr. A. R. Pewsey, 64, Cornhill, E.C.3.
LONDON—L. E. Ware, 20, Elspeth Road, Clapham Common, S.W.11.
MACCLESFIELD—H. Shufflebothan, 62, Waters Green.
MAIDSTONE—Mr. A. G. Freeman, " Sesame," 90, Sutton Road, Maidstone.



Corner House (Corsham) M.C.—Excellent progress is being made and membership is steadily increasing. An Exhibition was opened by Mr. H. S. Lakeman, one of the masters at the Chippenham Secondary School. The display included a large Hornby Train layout in full operation, excellent working models built by members and a case of birds' eggs. The receipts exceeded £1 and the enterprise of members was highly praised in the "*North Wilts Herald*." Club roll: 16. *Secretary:* R. Bidmead, High Street, Corsham.

Whitgift School M.C.—Careful preparation contributed to the success of the fifth Annual Exhibition, held in conjunction with the School Stamp and Coin Club. The Meccano models on view and entered in the competitions arranged were of higher standard than in previous years, and a Hornby Train layout greatly attracted the visitors. A Lantern Lecture was given during the proceedings, the slides being kindly lent by Imperial Airways Ltd. Club roll: 41. *Secretary:* H. J. Kirby, "Minniscot," Riddlesdown Avenue, Purley, Surrey.

Morison Memorial M.C.—The seventh year of the club's activities has been brought to a successful conclusion by a Social, at which prizes won during the preceding sessions were distributed. A splendid spirit prevails in the club, and older members are very helpful to the younger ones in connection with the design and construction of models. Club roll: 32. *Leader:* Mr. A. Fraser, 167, Barns Street, Whitecrook, Clydebank.

Plymouth M.C.—Subjects of recent Model-Building Competitions have included Aeroplanes, Fire Engines, Household Articles and Musical Instruments. All proved attractive to members, who also produced excellent models in a special Contest in which they were required to construct miniatures of objects that might be seen on a road. In view of the notes on Plymouth tramcar and bus services that appear in the "*Gear Box*," the club's magazine, special interest was taken in a visit to the Sheds and Workshops in which these are housed and repaired. Club roll: 70. *Secretary:* P. C. Frizzell, 85, Beacon Park Road, Swilly, Plymouth.

Dagenham M.C.—Membership continues to increase and a new club hall has been secured. Mr. J. Bush has kindly taken over the task of Leadership and this has led to an increase in enthusiasm. A successful Exhibition has been held and the proceeds devoted to an enjoyable club outing. During the summer Model-building Evenings and Sports Meetings are being held in alternate weeks. Club roll: 70. *Secretary:* S. Pashley, 84, Holgate Road, Dagenham.

St. John's School (Bridgwater) M.C.—The Annual Exhibition was held in the school. A complete Hornby Railway and a Meccano Fairground were on view in addition to a miscellaneous display of models, many of which represented dockyard subjects. No charge was made for admission, but a box for contributions in aid of the local hospitals was nearly filled by appreciative visitors. The success of the Annual Exhibition led to a request from the Hospital League to arrange a display at the Hospital Fete. This was accepted and members displayed great industry in making the necessary preparations. Club roll: 17. *Secretary:* L. Temple, 46, Monmouth Street, Bridgwater.

Bagshot and Lightwater M.C.—A special programme of outdoor meetings has included tracking events and a visit to Portsmouth Dockyard, where H.M.S. "*Iron Duke*," a Submarine and several Destroyers were seen, and H.M.S. "*Victory*" was inspected. The third Anniversary of the formation of the club was celebrated by a Picnic followed by Games. An interesting Visit was paid to a workshop in which remarkable models of wood and metal were made by means of a lathe. Club roll: 19. *Secretary:* P. Herridge, Cypress Cottages, Bagshot, Surrey.

Fulstow M.C.—Interesting Lantern Lectures and indoor games have been varied by Treasure Hunts, Cycle Runs, Miniature Rifle Shooting and other outdoor pursuits. A complete programme for the summer months has been arranged, and this includes cricket and other suitable amusements. Club roll: 11. *Secretary:* S. Doe, The Stores, Fulstow, North Thoresby, S.O. Lincs.

Old Charlton M.C.—The third Annual Exhibition included a Hornby Train layout, with colour light signals made by members, in addition to a large array of working models. Cinematograph Films were shown at intervals. The Mayor and Mayoress of Greenwich visited the Exhibition and presented prizes to members. Visitors were greatly impressed by the display, which was well reported in the local press. As a result of the Exhibition the club is now well known in the district and great progress is expected. Club roll: 22. *Secretary:* B. Stevens, 53, Mount Street, Charlton, London, S.E.7.



The Board of Directors of the Exeter M.C. Mr. M. C. Hodder, Leader since 1920, is second from the left in the front row; and on his right is Mr. J. Blaker, who is Joint Manager of the club with Mr. Hodder. The members of the Board are elected annually and are responsible also for conducting the affairs of the associated Elmside Branch of the H.R.C.

Kendal M.C.—The fourth Anniversary of the club was celebrated by a Feast. The preparations were so enthusiastic that members were unable to consume all the good things provided and they invited children from the streets to complete the task for them. The invitation was highly appreciated! Instructive and interesting films have been displayed and advantage has been taken of the fine weather to arrange cycle runs to Bowness and other attractive centres. A lecture is to be given by one member on "*Buying a House*," and others are looking forward with interest to what promises to be a novel contribution to the programme. Club roll: 15. *Leader:* L. Haslam, Middleton, Kirkby Lonsdale, Carnforth.

Wednesbury and District M.C.—A visit to a Trades Exhibition at Birmingham was followed by special Model-Building Contests. Lectures on the lives of great engineers have proved attractive to members. Cricket is the chief outdoor pursuit, but Rambles and other outdoor meetings also are arranged. At special meetings short stories are read by members, and an evening devoted to a Table Tennis Tournament was remarkable for the number of exciting and keenly contested games. New members are needed and the secretary will be very pleased to hear from Meccano boys who wish to join the club. Club roll: 9. *Secretary:* A. L. Morgan, 17, Cobden Street, Falling's Heath, Wednesbury.

Middlesbrough M.C.—Interesting events have included a Lantern Lecture on "*The Centenary of Railways*," slides for which were kindly lent by the L.N.E.R., and a short talk, given by one of the members, on the new bridge across the Tees. The sixth Annual Parents' Evening attracted a good attendance. Visitors were interested in the proceedings of the club and particularly in a Lantern Lecture on "*Transport in Industry*" kindly loaned by Cadbury Bros. Ltd. Club roll: 45. *Secretary:* L. Weighell, 42, Bishopton Road, Middlesbrough.

Sid Vale M.C.—The usual type of programme is being followed in a very competent manner, a skilfully varied selection of subjects giving members experience in designing and constructing a wide range of models. A Lecture on "*The Stamps of Great Britain*" given by Mr. Gliddon was of very great interest to members. Other meetings have included Games Nights and Evening Rambles. Club roll: 25. *Secretary:* R. Gliddon, Sheffield House, Sidmouth.

Australia

Melbourne M.C.—A Model-Building Meeting of exceptional interest was devoted to the construction of models of household articles. A special "Railway Night" was spent in building Meccano accessories for the club track and in making use of them. A service of electric trains is now run at Hornby Railway meetings, and signals are interconnected with the points so that the trains cannot be given the "All Clear" signal until the points are correctly set. Visits have been paid to the North Melbourne Locomotive Depot, where members enjoyed a footplate trip on an engine of the "Pacific" type, and to the Victoria Docks, the "*Argus*" Newspaper Office and the Melbourne Train Control Rooms. Club roll: 12. *Secretary:* L. S. Osborne, Lonsdale Street, Dandenong, Victoria, Australia.

India

Kognolkar M.C.—Model-building Competitions continue to be held regularly, and to arouse great interest. A recent visitor was Mr. S. N. Bhargave, who spoke in an interesting manner on club programmes. Gardening is the chief outdoor hobby of members, and the club must be unique in its possession of a very attractive flower garden. Club roll: 9. *Secretary:* R. M. Kognolkar, Nowgong C.I. India.

South Africa

Malvern M.C.—Members continue to be very active in all branches of club work. A special Exhibition and Concert in aid of charity yielded no less than £60. It was opened by Mr. D. Penry Roberts, Mayor of Johannesburg, and included stalls at which goods presented by friends of the club were sold, in addition to a splendid array of Meccano models. The models reflected the improvement in design and construction recently shown by members, and greatly interested the Mayor and other visitors. The event was very favourably mentioned in the Johannesburg "*Star*." Club roll: 80. *Secretary:* Mr. A. Hubbard, P.O. Box 8, Cleveland, Johannesburg, South Africa.

Western Province M.C.—Members continue to concentrate on model-building. Some models are constructed at the meetings and others are built by members at home and brought for inspection and criticism. Recent outstanding models have included an excellent Tank steered by means of clutches controlling the creeper tracks, a heavy Lorry 38½ in. in length, a small Tractor in which reduction gearing of ratio 27 : 1 was incorporated and a Brake Horse Power Meter working on the principle of the Daimler Fluid Flywheel. A new clubroom has been secured and fitted up to enable good model building work to be carried on. Club roll: 50. *Secretary:* P. K. Wiener, "Balcairn," Eden Road, Claremont, South Africa.

HORNBY SERIES

HORNBY ACCESSORIES

GAUGE O



TUNNEL No. 0 (Straight)
Length 6 in., width 6⅛ in.
Price **1/6**

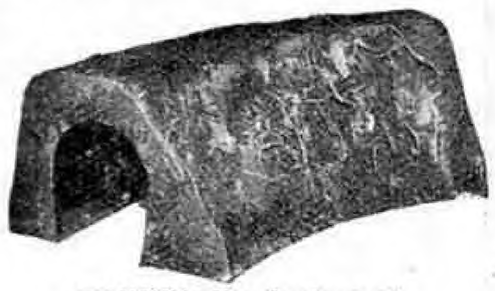
TUNNEL No. 1 (Straight)
Length 7 11/16 in. Width 6¼ in. (as illustrated).
Price **2/-**

TUNNEL No. 2 (Straight)
Length 15⅝ in. Width 9⅛ in. Price **4/-**



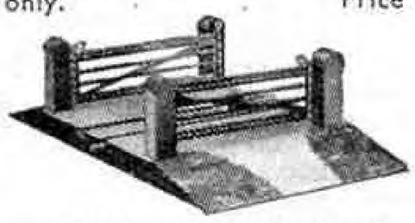
TUNNEL No. 5
(LEFT-HAND, CURVED)
(as illustrated)
This tunnel is in the form of a small hill, through which the track runs obliquely. For 2 ft. radius tracks. Base measurement: 15⅞ in. x 14⅜ in. Length of track 17¼ in. Price **7/6**

TUNNEL No. 6
(RIGHT-HAND, CURVED)
Similar to No. 5 Tunnel, but with track in the reverse position. For 2 ft. radius tracks only. Base measurement 15⅞ in. x 14⅜ in. Length of track 17¼ in. Price **7/6**



TUNNEL No. 3 (Curved)
Length 13 in. Price **4/6**

TUNNEL No. 4 (Curved)
(as illustrated)
Length 20 in. For 2 ft. radius tracks only. Price **5/6**



LEVEL CROSSING No. 1
Suitable for a single track only and has gauge O rails in position.
Price **3/6**

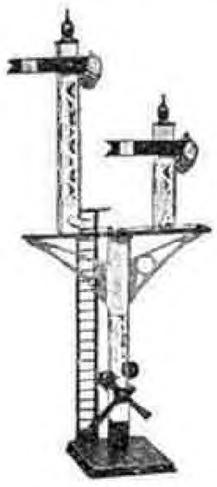


LEVEL CROSSING No. 2
Measures 13½ x 10¼ in., with two tracks of gauge O rails in position.
Price **5/6**

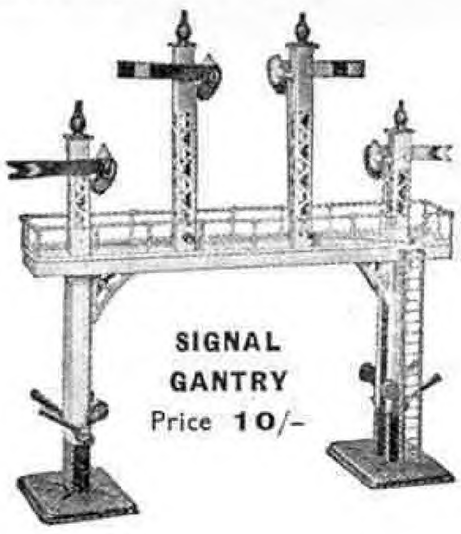
LEVEL CROSSING No. E2
(Electrical)
Similar to Level Crossing No. 2 excepting that a third rail is fitted in each of the two tracks.
Price **7/6**



STATION No. 2
Excellent model, beautifully designed. Built up in three detachable sections. Length 2 ft. 9 in., breadth 6 in., height 7 in. Price **10/-**



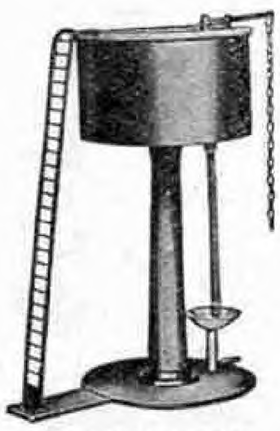
JUNCTION SIGNAL
"Home" or "Distant," Signal arms operated by levers at base. A very realistic model.
Price **6/-**



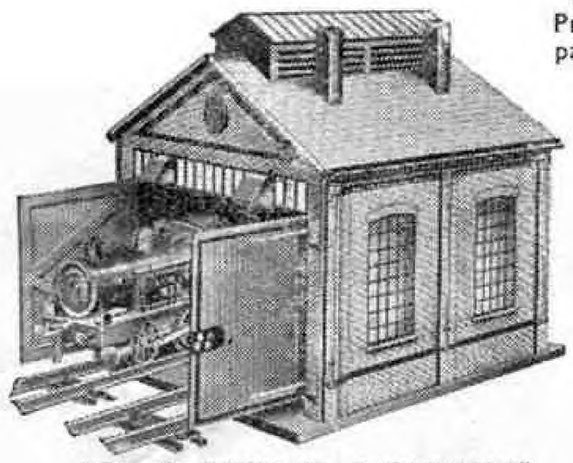
SIGNAL GANTRY
Price **10/-**



TELEGRAPH POLE
Price per pair **4/-**



WATER TANK
Fitted with flexible tube and valve lever.
Price **8/6**



ENGINE SHED No. 1 (illustrated)
This Shed will accommodate Locomotives and Tenders of the M Series and No. 1 Tank and No. 1 Special Tank Locomotives.
Price **15/-**

ENGINE SHED No. 2
This Shed will accommodate any Locomotive and Tender in the Hornby Series.
Price **22/6**



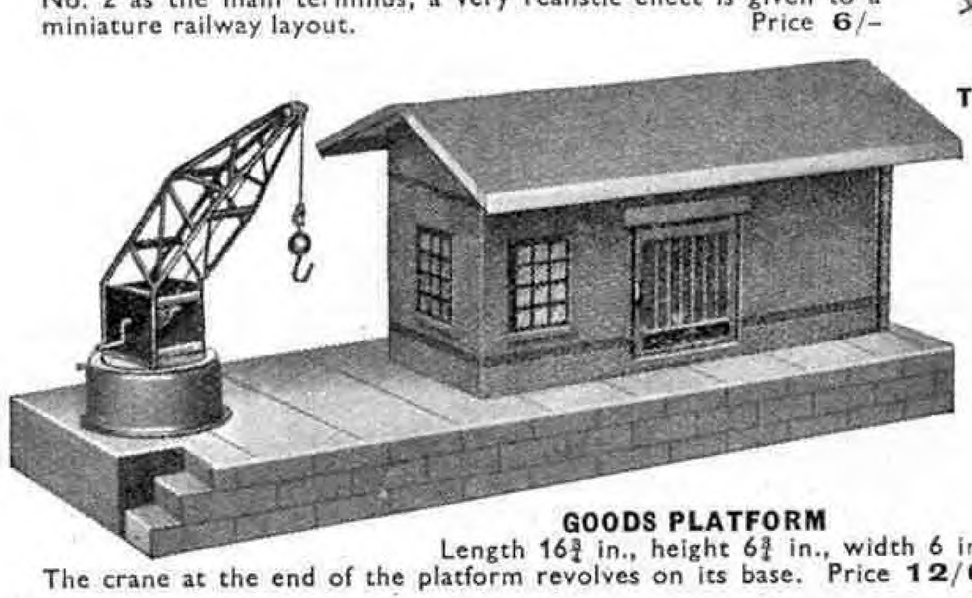
M TELEGRAPH POLE No. 2
Price **4**d. each.



STATION No. 1
Length 16¾ in., width 6 in., height 6 in. This Station is a well-made model, richly finished in bright colours. By placing several of these Stations at intervals along the track, and using the Railway Station No. 2 as the main terminus, a very realistic effect is given to a miniature railway layout. Price **6/-**



TURNTABLE No. 2
Price **4/6**



GOODS PLATFORM
Length 16¾ in., height 6¾ in., width 6 in.
The crane at the end of the platform revolves on its base. Price **12/6**



Cutting No. 4

CUTTING No. 4 (STRAIGHT)
This is a double cutting, mounted on a base over which the railway track is laid.
Base measurement: Length 15⅜ in., width 15 in. Price **6/-**



Two No. 1 and one No. 2 Cuttings are illustrated here.

CUTTING No. 1 (END SECTION)
(illustrated)
Base measurement: Length 7 11/16 in., width 6 in.
Price, per pair **3/-**

CUTTING No. 2 (CENTRE SECTION, STRAIGHT)
(illustrated)
The addition of these centre sections enables a Hornby Railway cutting to be extended to any length. They are intended to be used in conjunction with the End Sections (Cutting No. 1), between which they are fitted.
Base measurement: Length 10¼ in., width 6 in.
Price **2/-**

CUTTING No. 3 (CENTRE SECTION, CURVED)
This is used for curved tracks in the same manner as the straight centre section, described above, is used for straight tracks. It is suitable for both 1 ft. and 2 ft. radius tracks. Price **2/-**



BUFFER STOPS No. 2
(Hydraulic type). Price **5/6**



SIGNAL CABIN No. 1
Finished in colours. Price **2/9**
SIGNAL CABIN No. 2 (illustrated)
Dimensions: Height 6½ in., width 3⅛ in., length 6⅛ in. Roof and back open to allow Lever Frame to be fitted inside cabin if desired.
Price **4/6**



No. 1 FOOTBRIDGE WITHOUT SIGNALS
Price **4/-**
No. 1A FOOTBRIDGE, COMPLETE WITH SIGNALS Price **4/9**
No. 2 FOOTBRIDGE, COMPLETE WITH DETACHABLE SIGNALS
(as illustrated). Price **7/6**
Signals only (for Footbridge No. 2)
Price, per pair **3/9**

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Branch News

ELMSIDE (EXETER).—Traffic on the Branch track continues to be very dense. One of the directors acts as superintendent at each meeting, and carefully prepared plans are put into operation under his direction. The directors are elected by members. Their meetings are held weekly and are followed by business meetings of the Branch, Mock Trials, or a series of short speeches by members. An interesting innovation is a Poor Box, to which members are invited to contribute. Secretary: D. Legg, 25, Chute Street, Exeter.

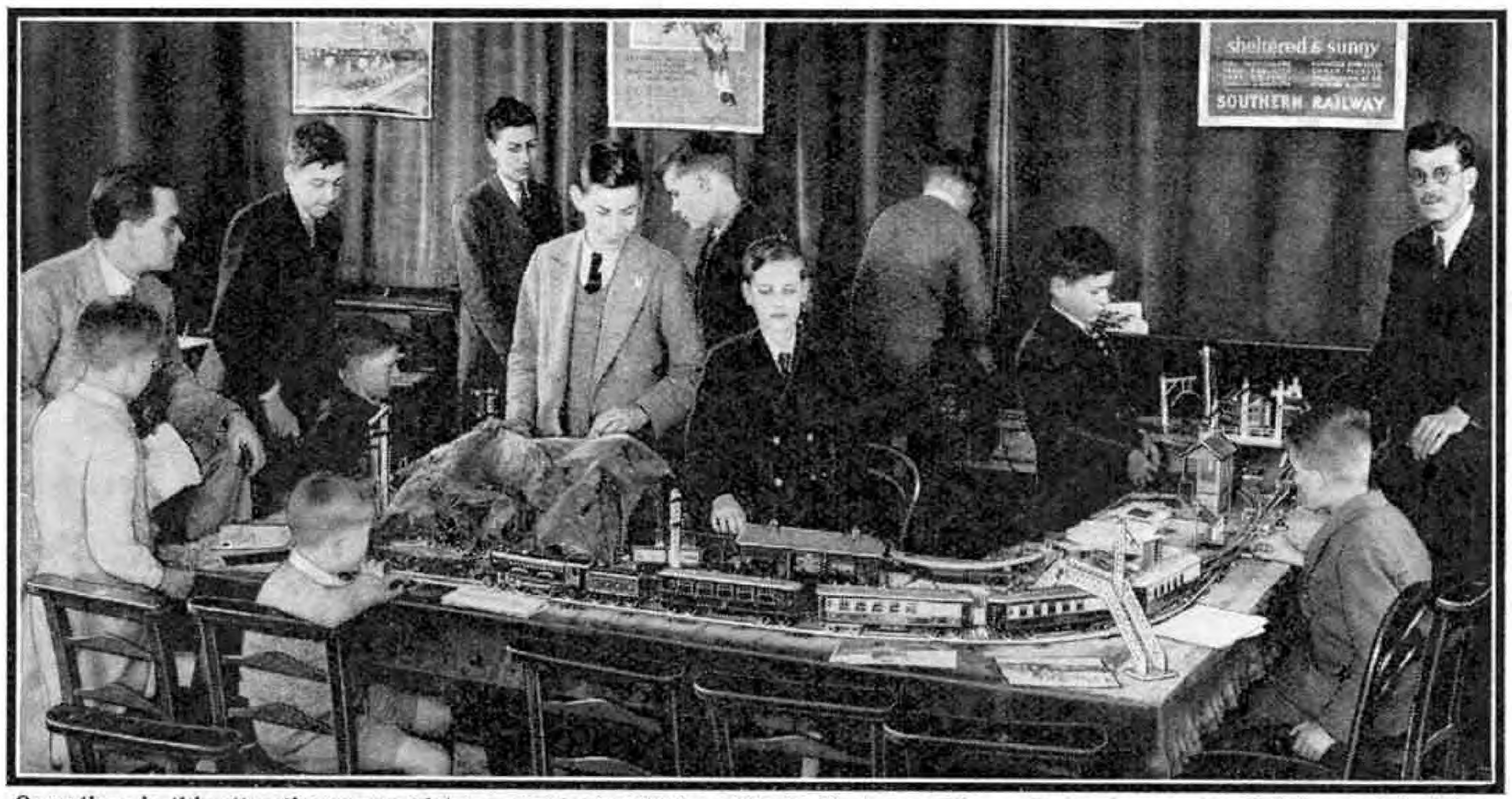
WOODFORD.—Track Drawing Competitions are a feature of Branch work, in which members are greatly interested, and a Challenge Cup is awarded as a result of the regular contests arranged. The Annual Party was very enjoyable and other social events have added to the interest of track operations, which are carried on at regular meetings. It is hoped that the resources of the club will be increased by the acquisition of new members, and those interested should apply to the secretary for details. Secretary: T. J. Skelt, Walberswick, 27, Woodside Road, Woodford Wells, Essex.

CRAIGIE (PERTH).—Great interest is taken in track meetings, when all railway work, whether in connection with maintenance or running, is carried out under the direction of responsible officials with correct railway titles. Outdoor and indoor games give variety to the programme, and members thoroughly enjoy fierce bouts with a large punch ball that has been installed in the Branch room. A model farmyard is to be installed in order to improve the appearance of the surroundings of the track, and the library is being extended. Secretary: S. J. Hardman, 16, Priory Place, Craigie, Perth.

COTTESMORE.—An excellent programme has been arranged for this newly incorporated Branch. Operations on a track 250 ft. in length on which six engines are run are carried on at special weekly meetings, and additional meetings are arranged regularly for Lantern Lectures and trials of experimental layouts designed by members. Excursions already arranged include a trip by motor boat on the Trent, and visits to Hull and Grimsby Docks and to Colwick Goods Yard. Secretary: J. S. Butler, Cottesmore Central School, Lenton, Nottingham.

PEVERIL (MANCHESTER).—Regular timetable running is now in full swing, each member being given definite tasks to be performed in order to ensure smoothness and efficiency in working. Competitions in operating skill also are arranged, members being divided into teams for this purpose, and at one specially interesting meeting a track with a heavy gradient was used for testing locomotives. On Games Nights draughts and chess are played and jig-saw competitions held. Other attractions have included a Cinematograph Show, and cycle runs. Secretary: R. A. Owens, 18, Amherst Road, Fallowfield, Manchester, 14.

HILLPLACE (CRAWLEY).—An excellent double track has been developed and members are becoming both skilful in operations on it and enthusiastic. Improvements are being made continuously, and in such a manner that working is not hindered. Two members who damaged an engine without excuse have been temporarily suspended from membership. Secretary: B. Delany, Purple Ridge, Colemans Hatch, Sussex.



Operations in this attractive corner of the successful Exhibition of the St. Saviour's (Raynes Park) Branch, No. 236, fascinated visitors of all ages. On the left is Mr. Willoughby, Chairman, and Mr. A. H. Williams, secretary, is on the right. Our photograph, which is reproduced by courtesy of the "Wimbledon Borough News," shows that effective use is made of posters in decorating the Branch room. The display aroused great interest and several new members were enrolled during the proceedings.

AUSTRALIA

PARRAMATTA.—Meetings are arranged to suit the convenience of members, who cannot attend at set times. Some of them come a considerable distance, one travelling 24 miles by boat, tramcar, train and bus in order to be present. All are keen enthusiasts and one is a locomotive driver. The Branch track now provides for excellent passenger and goods working on a non-continuous layout with two termini and a wayside station. Operations are very realistic and members are keen on improving working. Secretary: H. H. Matthews, 27, Ross Street, Parramatta, N.S.W., Australia.

PERTH.—So far members of this newly incorporated Branch have been busily engaged in building their track. The Branch room was opened on special nights to enable this work to be completed as soon as possible. The layout includes four stations and two signal boxes fitted with telephones or buzzers, and members are looking forward to enjoyable times when operations are in full swing. Secretary: J. Stanbridge, 285, Lord Street, Perth, Western Australia.

Branches in Course of Formation

The following new Branches of the Hornby Railway Company are at present in process of formation and any boys who are interested and desirous of linking up with this unique organisation should communicate with the promoters, whose names and addresses are given here. All owners of Hornby trains or accessories are eligible for membership and the various secretaries will be pleased to extend a warm welcome to all who apply.

BATTLE—A. G. Forsyth, Glengorse, Telham Court, Battle, Sussex.

DAGENHAM—G. Green, 21, Ellerton Gardens, Dagenham, Essex.

HEMEL HEMPSTEAD—S. Phillips, St. Paul's Vicarage, Hemel Hempstead.

Boys! Here's the finest part exchange offer ever made

Just think of it, an allowance of 50% on your old Hornby Locomotive! This is the most generous offer ever made to Hornby Train enthusiasts.

The complete list of Part Exchange allowances for Hornby Locomotives is given on this page. Please note that the catalogue price of the new Locomotive you purchase *must not be less than double the Part Exchange allowance made for your old Locomotive.*

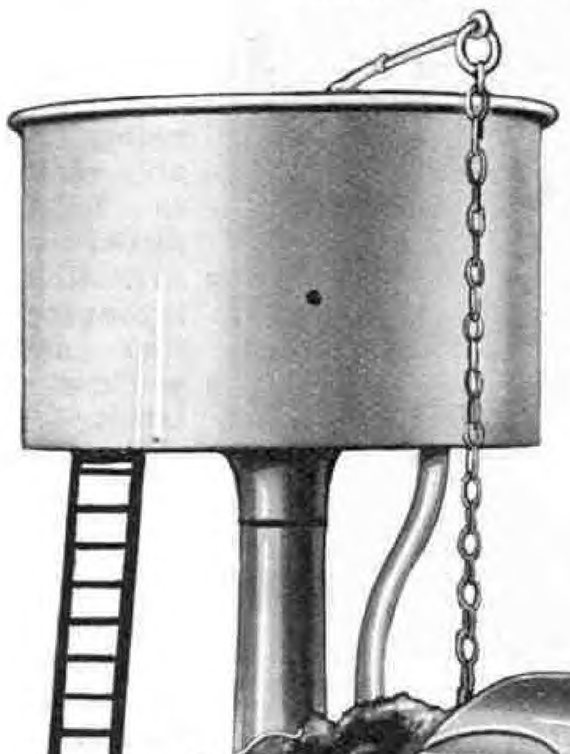
Here is an example of how the plan works. Assuming you have a No. 1 Tank Locomotive that you wish to exchange, you see from the list that its exchange value is 6/3. You then choose a new Locomotive, the cost of which is not less than 12/6.

You decide, say, to have a No. 2 Special Tank, the price of which is 25/–. Pack up your old No. 1 Tank and deduct 6/3 from 25/– (the price of the new No. 2 Special Tank) enclose a remittance for 18/9 plus 1/– carriage on the new Locomotive—19/9 in all. Send the Locomotive and the remittance to Meccano Limited, Binns Road, Liverpool 13.

Alternatively, you can take your old No. 1 Tank Locomotive to your dealer with a remittance for 18/9, and he will give you the new No. 2 Special Tank Locomotive that you require.

HORNBY TRAINS

BRITISH AND GUARANTEED



NO MATTER WHAT THE AGE OR CONDITION OF YOUR OLD LOCOMOTIVE, YOU CAN EXCHANGE IT UNDER OUR "PART EXCHANGE" PLAN.





Part Exchange Allowances for Hornby Locomotives

CURRENT TYPES

MO Locomotive	1/4
M1/2 Locomotive	2/3
M3 Tank Locomotive	3/9
No. O Locomotive	5/3
No. 1 Tank Locomotive	6/3
No. 1 Locomotive	6/3
LEC 1 Locomotive (Swiss Type)	7/6
No. 1 Special Locomotive	8/3
No. 1 Special Tank Locomotive	8/3
LST M3/20 Tank Locomotive (20-volt)	11/3
No. 2 Special Locomotive	11/3
No. 2 Special Tank Locomotive	11/3
No. 1 Electric Tank Locomotive, Permanent Magnet	12/6
LST 1/20 Tank Locomotive (20-volt)	12/6
LE 1/20 Locomotive (Swiss Type), 20-volt	13/3
LE 2/20 Locomotive (20-volt)	16/6
No. 2 Electric Tank Locomotive	18/9
No. 3E Locomotive	18/9
No. 3E Riviera "Blue" Locomotive	18/9
No. 3C Locomotive	13/9
No. 3C Riviera "Blue" Locomotive	13/9
Metropolitan C Locomotive	11/3
Metropolitan L.V. Locomotive	20/–

OBSOLETE TYPES

M2930 Locomotive	1/–
George V Locomotive (These models were identical)	3/3
No. OO Locomotive (These models were identical)	3/3
M3 Locomotive	4/3
Zulu Locomotive	5/3
Zulu Tank Locomotive	6/3
No. 2 Locomotive	10/–
No. 2 Tank Locomotive	11/3
No. 1 Locomotive, fitted for Hornby Control	7/6
No. 1 Tank Locomotive, fitted for Hornby Control	7/6
No. 2 Locomotive, fitted for Hornby Control	11/3
No. 2 Tank Locomotive, fitted for Hornby Control	12/6
Metropolitan H.V. Locomotive	20/–

Hornby Locomotives are the Longest Running and Strongest Pulling Locomotives in the World.

MECCANO LIMITED
Binns Road, Liverpool 13

First Steps with a Hornby Railway

Layouts with 2 ft. Radius Curves, Points and Crossings

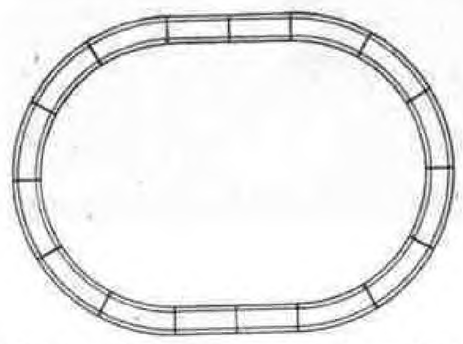


Fig. 1. Rails required (2 ft. radius) : 12 Curves, 4 Straights.

IN the last two articles under this heading we have considered the possibilities of layouts formed of 9 in. radius and 1 ft. radius rails, and the corresponding points. We now come to the rails and points of 2 ft. radius.

The first point to be noted is in connection with the all-important matter of the space available for the layout. A circle of 2 ft. radius rails measures approximately 4 ft. 3 in. across, so that, in order to allow for the overhang of locomotives and vehicles on the rails, the absolute minimum width required for a 2 ft. radius layout is 4 ft. 6 in.

A 2 ft. radius curved rail forms one-twelfth part of a circle, so that a full circle is composed of a dozen of them. The deviation from the straight of each 2 ft. radius rail is therefore exactly half that of a 1 ft. or 9 in. radius rail, for each of these forms one-sixth of its respective circle. This, with the fact that half and quarter curved rails are available, greatly increases the scope of layouts formed with 2 ft. radius rails.

In Fig. 1 there appears a simple oval layout incorporating 2 ft. radius curves. Six of these rails form a half circle at each end of the layout, the intervening space being filled by two straight rails at the top and bottom of the plan. This is a form of layout that can be extended indefinitely. A possible extension is shown in Fig. 4. Here each quarter-circle formed by three 2 ft. radius curves is joined to the next by two straight rails. This effect would be gained by dividing horizontally into two halves the layout in Fig. 1, and adding the necessary straight rails.

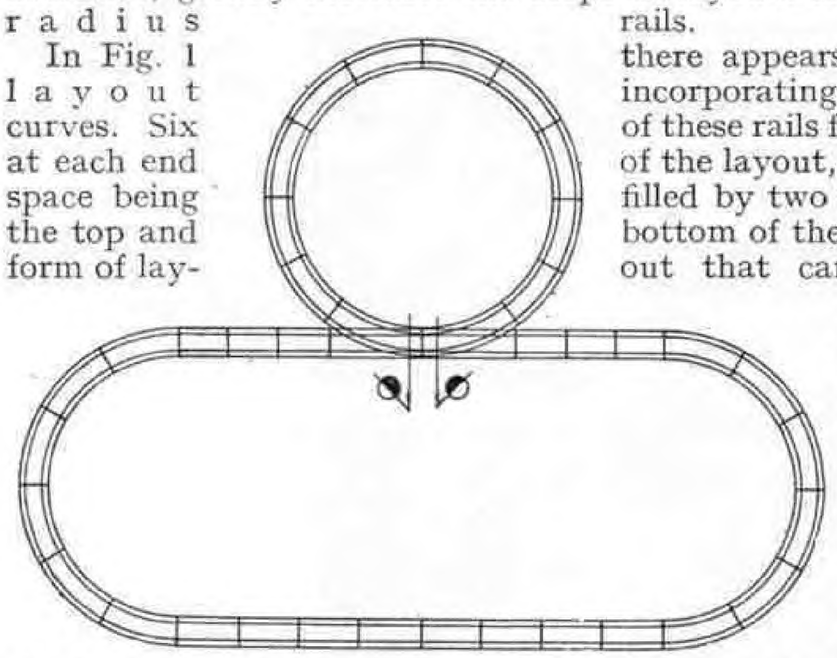


Fig. 2. Rails required (2 ft. radius) : 22, Curves, 14 Straights, Right-hand Points, Left-hand Points.

Turning now to the use of Points, it should be noted that the ordinary Left-hand and Right-hand 2 ft. radius Points, like the 1 ft. radius points that we have mentioned previously, bear a fixed relation to the standard straight and curved rails. Thus the length of the straight portion of the points is $10\frac{1}{4}$ in., and the curved portion forms one-twelfth of a circle, each dimension exactly corresponding to the ordinary rails. Therefore the use of points as shown in Fig. 2 presents no difficulty.

Another interesting instance of the use of points is found in Fig. 3. This layout consists essentially of an oval track, the upper side of which splits into two circular loops by means of Double Symmetrical Points. The semi-circular end parts of this layout are joined by straight rails along the lower edge of the plan, and the Double Symmetrical Points enable the circular loops at the top of the layout to be formed easily.

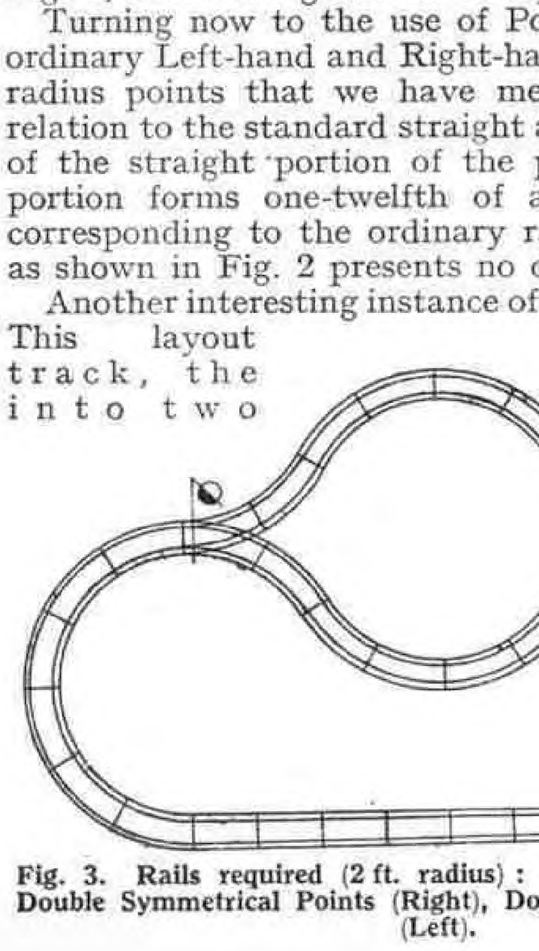


Fig. 3. Rails required (2 ft. radius) : 24 Curves, 8 Straights, Double Symmetrical Points (Right), Double Symmetrical Points (Left).

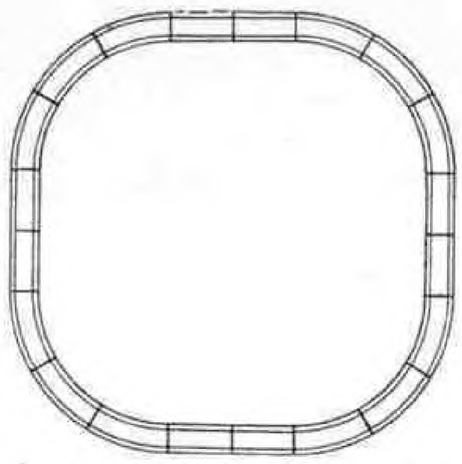


Fig. 4. Rails required (2 ft. radius) : 12 Curves, 8 Straights.

Apart from such regular formations, layouts having what we may call more angular corners than those of the usual oval can easily be assembled. Fig. 5 shows the triangular form of layout that we have met previously when dealing with 1 ft. radius rails. Each of the curved parts of this is made up of four curved rails, and the straight lengths are each formed of two standard rails. It is interesting to compare this with the requirements of the corresponding 1 ft. radius layout that was illustrated last month, where the use of exactly half as many rails, both straight and curved, was necessary.

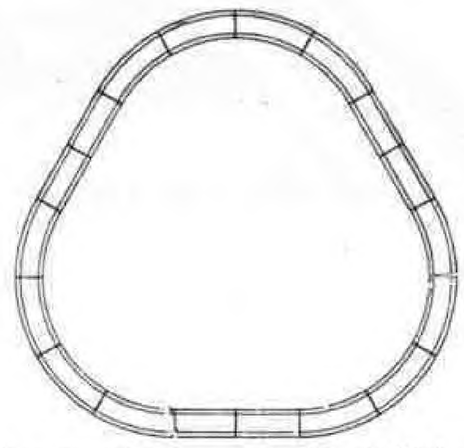


Fig. 5. Rails required (2 ft. radius) : 12 Curves, 6 Straights.

Crossings are frequently not exploited to the extent that they should be, possibly because their relation to the other rails is not fully understood.

Fig. 6 will enable the uses of the Right Angle pattern of Crossing to be seen. Here the layout may be considered as two practically separate ovals, one horizontal and the other vertical, intersecting by means of the Right Angle Crossings, and directly joined at the base of the layout by points. On the upper track of the horizontal oval the number of straight rails in between the two crossings should be noted. It is useful to remember that four straight rails are required to fill the space between two Right Angle Crossings that are situated on opposite sides of an oval track whose ends are made up of six curved rails only.

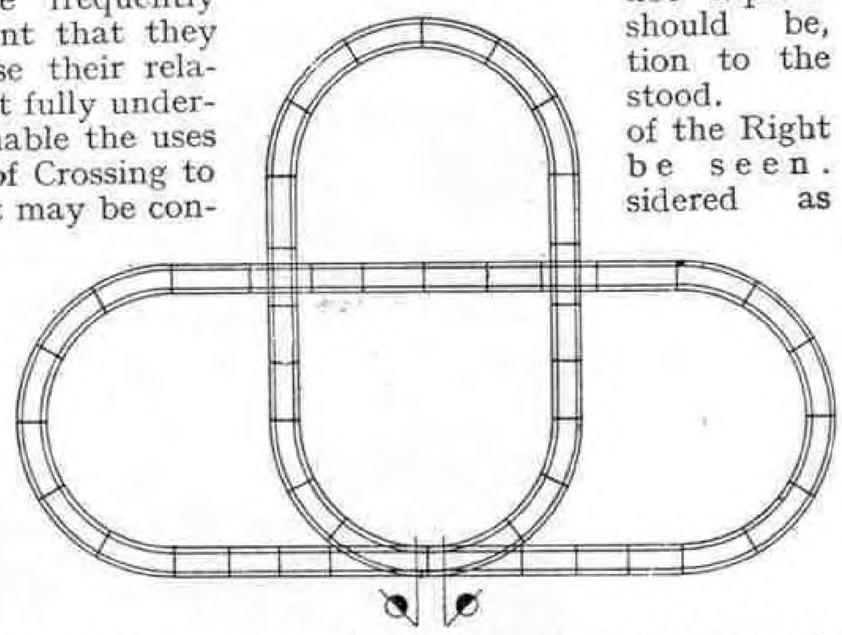


Fig. 6. Rails required (2 ft. radius) : 22 Curves, 18 Straights, 2 Right Angle Crossings, Right-hand Points, Left-hand Points.

Fig. 7 will enable something of the effect of the Acute Angle Crossing to be appreciated. First let us consider the upper and lower portions of the layout separately, as they would be before the introduction of the crossing connecting them. The upper portion would be a plain oval and the lower portion a diamond-shaped formation. After the removal of the two middle curved rails at the bottom of the oval, and the two curved rails at the top point of the diamond, the gaps left are filled up by the Acute Angle Crossing with a single straight rail attached to each arm. Thus the two formerly independent layouts become joined together as a continuous system, the result appearing as shown in the diagram. Interesting extensions of the layout are possible, especially if further Crossings can be included.

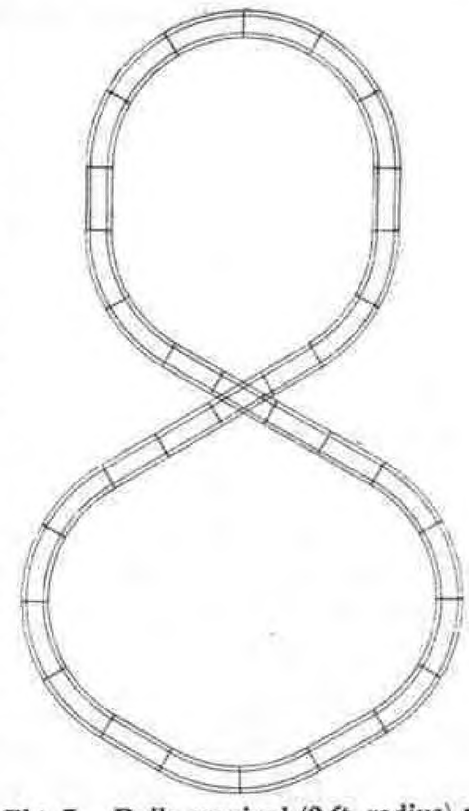
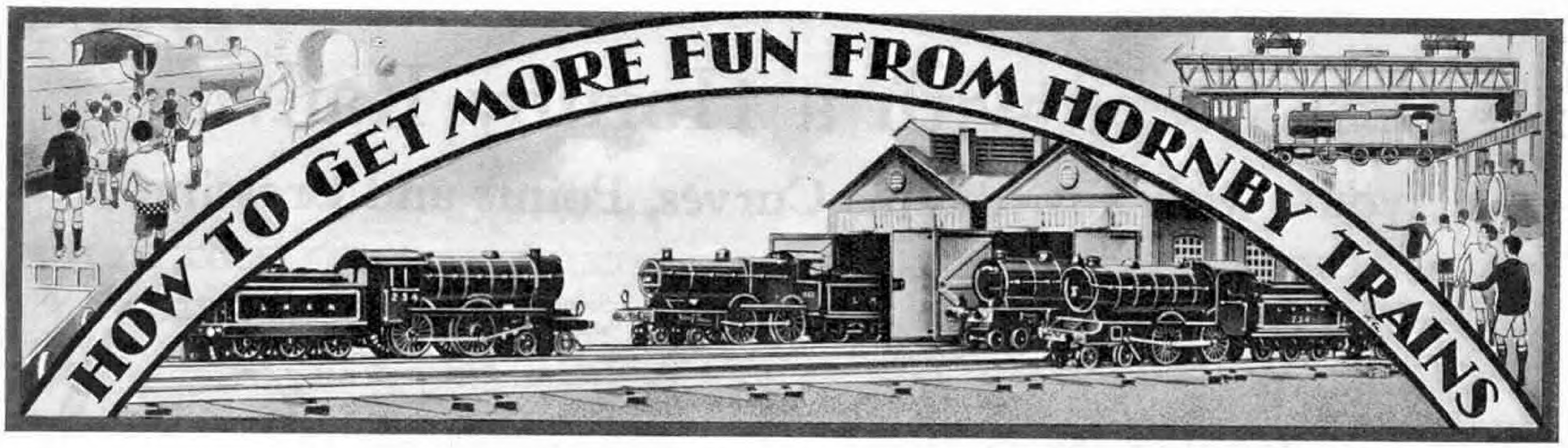
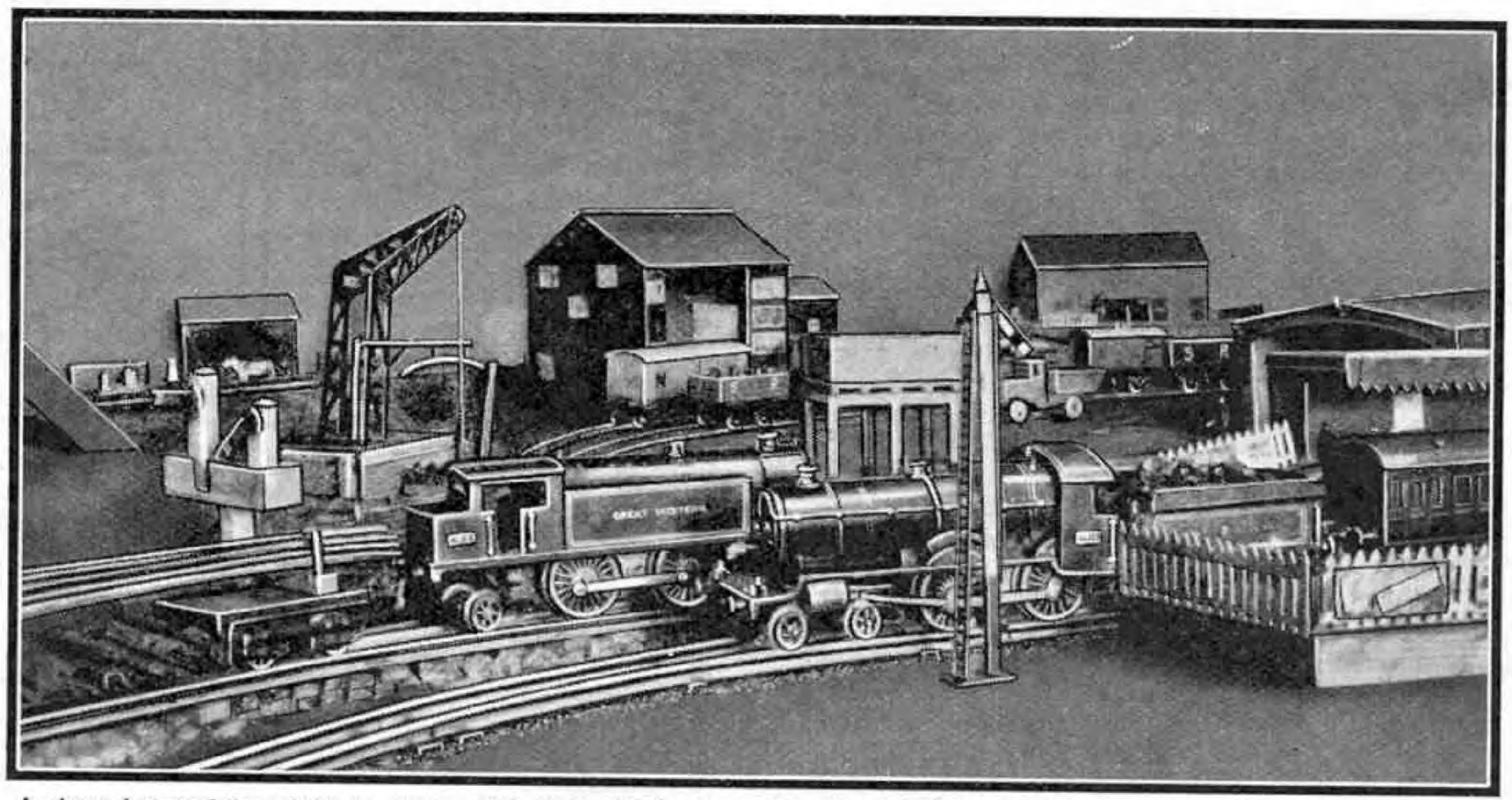


Fig. 7. Rails required (2 ft. radius) : 20 Curves, 10 Straights, Acute Angle Crossing.



LXX.—AN INTERESTING G.W.R. SYSTEM

FROM time to time in these pages we have devoted attention to miniature railway layouts developed by "*M.M.*" readers, and have described their chief features and the operations usually carried out on them. The layout shown on page 659 is interesting in several respects. The actual plan of the line is perhaps unusual, but the amount of space available gives great scope, and the layout as shown is considerably more interesting than a large oval covering approximately the same area would have been. It is one of those systems, which are growing in number, that follow the practice of a particular group in their equipment, even though the plan may not be based on any special district or section of line. Another point is that most of the lineside accessories and buildings have been constructed at home by the owner of the railway, D. Bolt of Princetown, who is a keen "*M.M.*" reader and enthusiastic member of the Hornby Railway Company.



A view of part of the miniature system of D. Bolt of Princetown. The line is fully equipped with rolling stock and accessories and its operation is based on G.W.R. practice.

The track consists essentially of two main oval systems that connect at the station shown in the centre of the layout. The lower oval forms the main line, and accommodates both up and down traffic on separate tracks. These are separate sets of ordinary rails and are not formed of Hornby Double Track, but the result is quite satisfactory. The upper single line oval is used more in the nature of a branch line, so that its equipment generally is on a simpler scale.

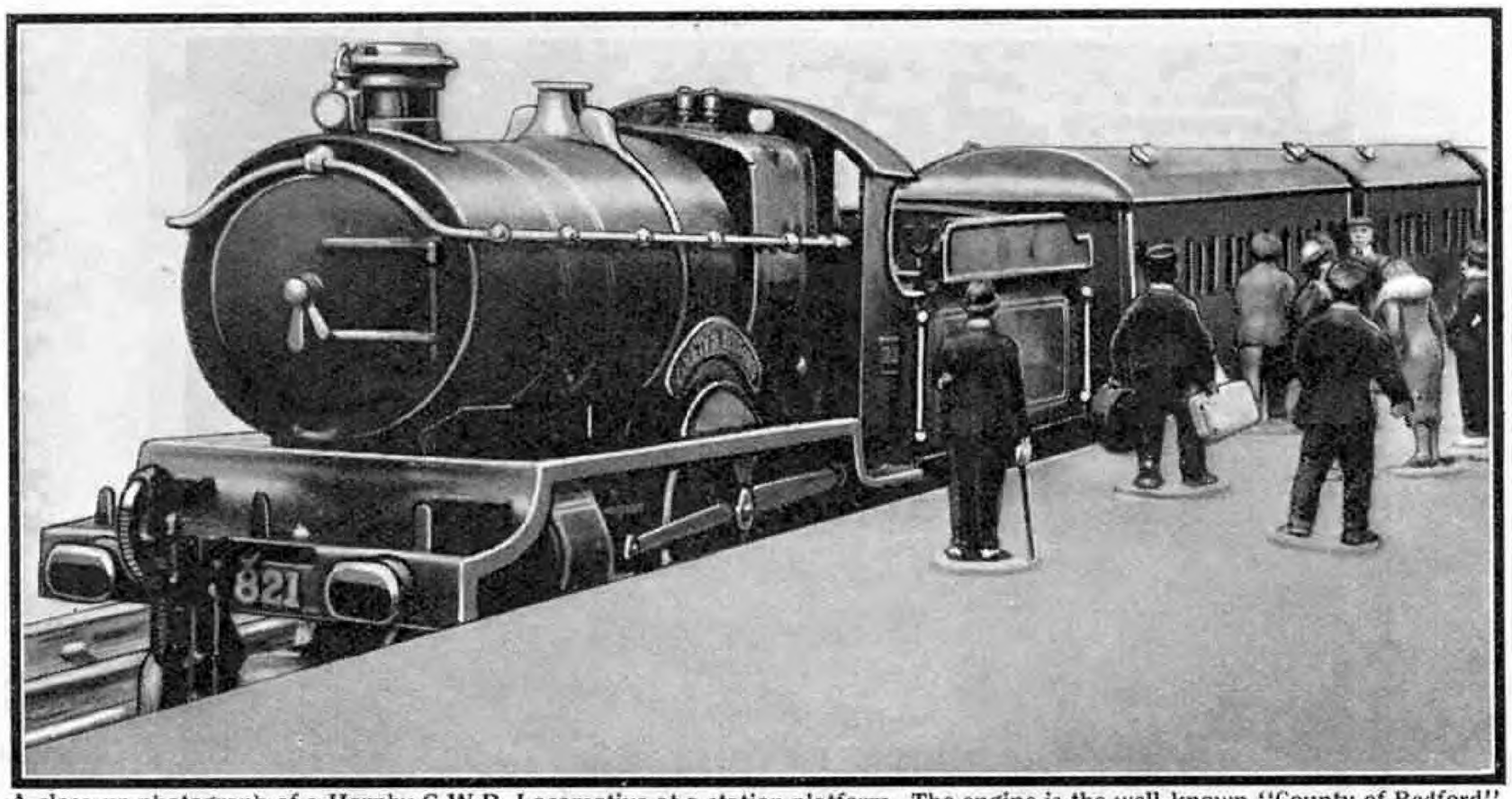
Within this upper oval there are several sidings forming a goods yard with a goods station, and there is also an engine shed and other accessories. The actual disposition of these within the branch line oval leaves the main running tracks free of any obstructions, so that it is relatively easy to conduct traffic on this system. The layout as a whole may be considered as an elaborate development of the familiar rail formation consisting of two oval tracks. The connections between the two ovals are arranged in an interesting manner at the junction station. The use of various pairs of points together makes up what amount to crossover connections between the two systems, and similar arrangements are in use elsewhere on the double track or main line circuit.

In a layout of this kind it is sometimes difficult to find a satisfactory use for a crossing such as every enthusiast obtains early in his miniature railway career, when the original circle develops into a "figure eight" formation. Reference to the diagram will show how an acute angle crossing has been made use of in a very practical manner. It forms part of the branch line system as the latter diverges from the main line, and it provides also a convenient means of access to the inside of the branch oval from the latter. It enables the line from the points that are thrown off the main oval at the left-hand side of the diagram to cross the branch on the level. An advantage of the crossing here is that, unlike points, it does not require to be set for a train on either line. It is always in the correct position, as the rails forming the centre of the crossing are fixed. Therefore less work is involved, though care must be taken that the line is clear before any trains are allowed to negotiate the crossing. Branch line traffic is not likely to be frequent, so that the crossing of the branch on the level by the connecting line is not an objection.

Owing to the arrangements of the various tracks it is possible to operate three trains on the layout at the same time. Two of these will be travelling on the main line, one in the up direction and the other in the down. The remaining train will run on the branch line, and any of the three may be composed of passenger or goods rolling

stock as required by the working timetables. Connections may be conveniently arranged between the main and the branch trains at the junction station, and the whole of the working carried out in a realistic way. The junction station is an important centre, and the layout of the track in its vicinity is quite interesting.

Between the two platforms there are three tracks, the centre one providing a through road in one direction for non-stop main line trains. Alternatively it may be used for refuge purposes for goods or slow trains, or possibly for the temporary storage of rolling stock, in which event main line trains would be "looped" through the platform road. Such trains in the opposite direction have to use the platform track whether they are stopping or not. The uses of the crossing at one end of the station have already been referred to, but at the opposite end double symmetrical points enable the turntable in the yard to be reached and they also lead to the continuous branch line.



A close-up photograph of a Hornby G.W.R. Locomotive at a station platform. The engine is the well-known "County of Bedford" and is working a stopping train as shown by the single headlamp displayed in front of the chimney.

In addition to the junction station there is another main line station, the two platforms of which are connected by an overbridge in the usual way. Connection is provided between the up and the down road by means of two points used in conjunction to form a crossover. This connection is useful for various shunting movements, and is operated under the watchful eye of the signalman in his cabin adjacent to the points. There is a dead-end siding connected to the outer track by trailing points. This provides for the goods and coal traffic dealt with at the goods shed and coal depot, and a crane is also conveniently situated for loading and unloading purposes. At the outer end of this siding is a water tank placed to suit a locomotive shunting in the siding or on a train standing at the station platform. On the whole this forms a typical and realistic passing station. The branch line station is a simple, single-platform structure that does not require any detailed reference.

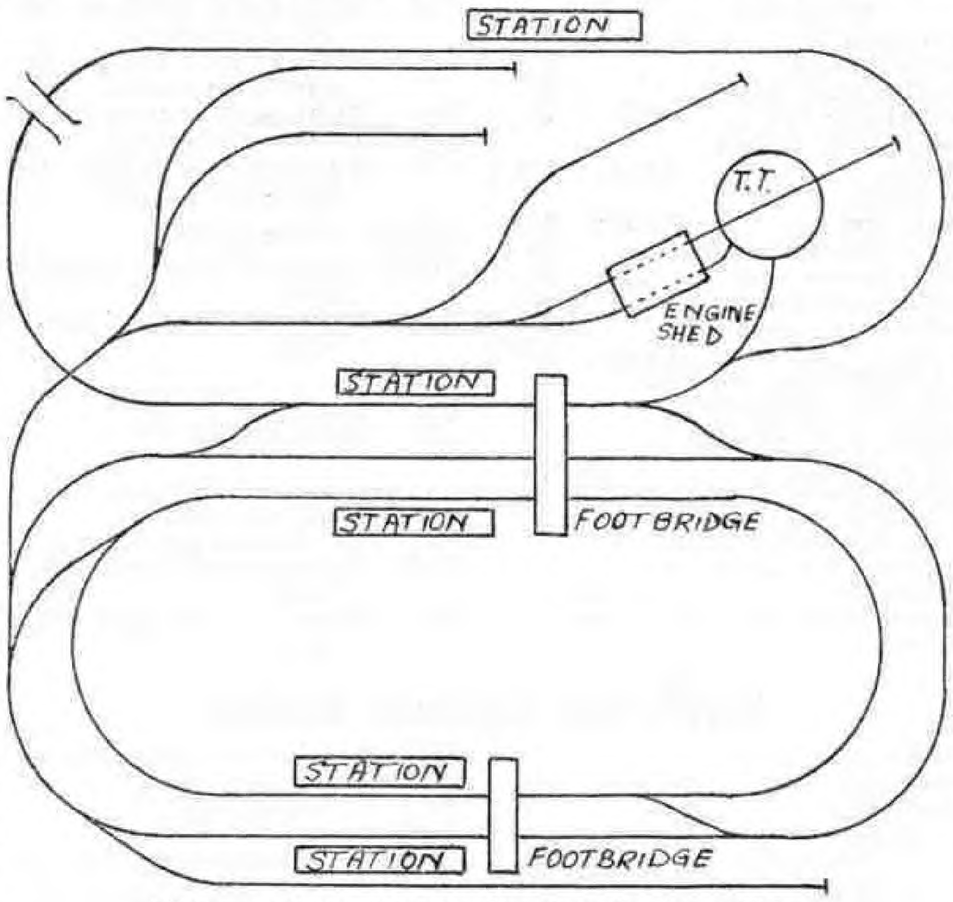


Diagram of the layout referred to in this article.

The yard situated within the upper oval or branch line is not elaborate, but the various tracks form an effective arrangement for operating purposes. There is a goods depot and a coal merchant's office, as often found in railway yards, and conveniently situated near the goods depot is a yard crane. The locomotive department also is accommodated within the oval branch track. A two-road engine shed is provided, and close to this is the turntable already referred to. The arrangement of the various tracks is such that locomotives may proceed directly from the turntable to the junction station, or vice-versa, without requiring to pass through the shed and possibly disturb other engines that are "off duty." A coal stack is provided beyond the turntable and adds a further touch of realism to the situation.

An interesting point regarding this West Country system is that, as might be expected, its operation and general scheme are based on the practice of the G.W.R. Thus all the locomotives are of Great Western types, and when seen together they make quite a smart and distinctive assembly. The chief express work is carried out by the Hornby No. 2 Special *"County of Bedford"* locomotive, and this is seen in the photograph showing the layout in operation. This is the only tender locomotive in use, the other four engines forming a family of tanks.

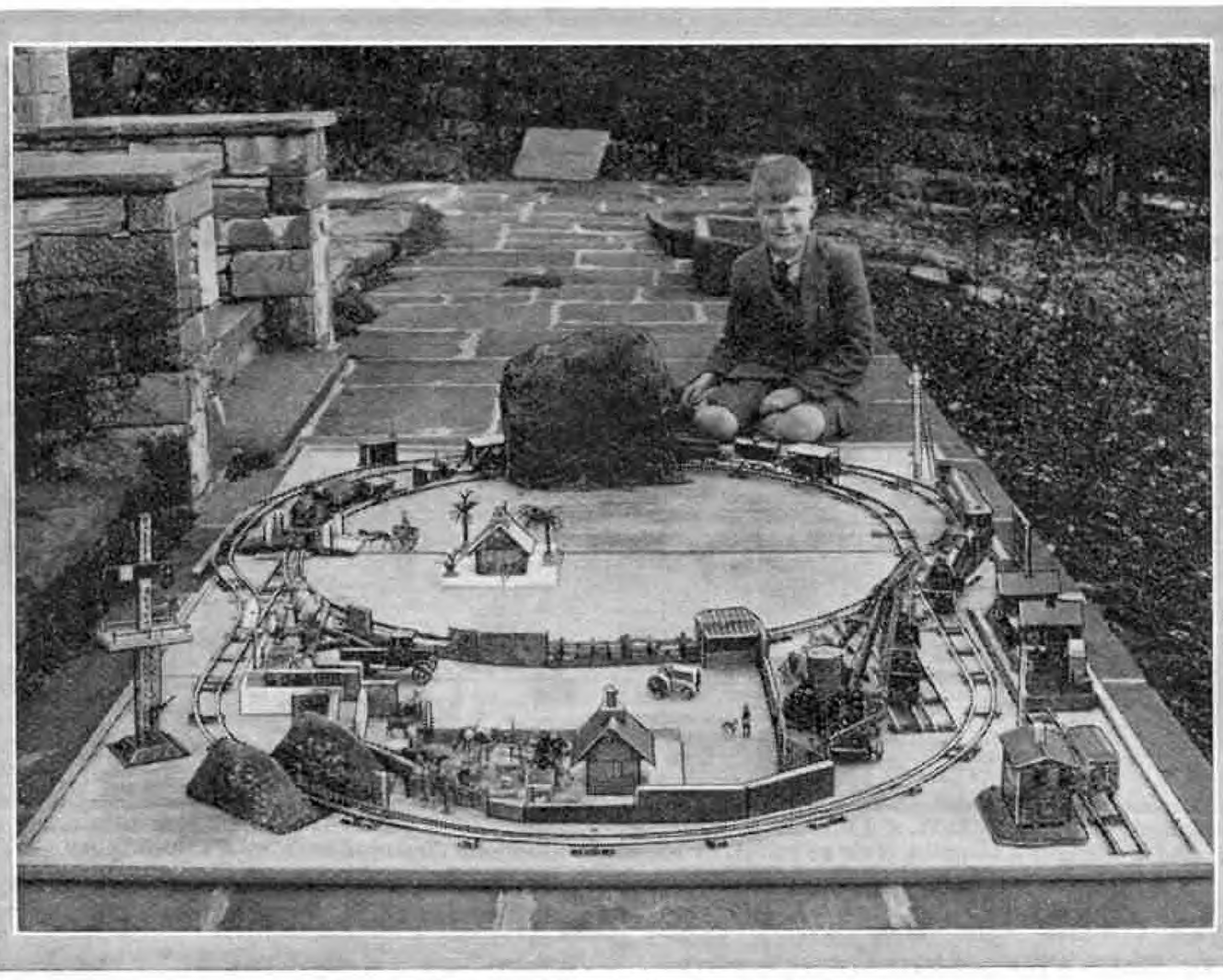
Shorter-distance and stopping passenger trains are operated by a Hornby No. 2 Special Tank Locomotive, and this deals also with much of the heavier goods working. Next in the scale of power and size is a Hornby No. 1 Special Tank that is useful for any kind of work, and is adaptable in miniature as are the real G.W.R. large 2–6–2 tanks, or "Big Prairies" as they are often called.

The smaller 2–6–2 tanks that are so much in evidence on the various subsidiary lines in the West and elsewhere are suitably represented by a Hornby No. 1 Tank Locomotive and the diminutive 0–4–2 tanks of real practice have an effective counterpart in the M3 Tank Locomotive.

Bogie rolling stock is employed for all passenger services and good use is made of Metropolitan Coaches as frequently suggested in these pages. A satisfactory variety of goods rolling stock is available, and a No. 2 Luggage Van and a No. 1 Milk Van are frequently included in the composition of passenger trains. These vehicles thus correspond to the *"Monsters"* and *"Siphons,"* as similar vehicles are named on the G.W.R. for the purpose of easy identification, and the Hornby Trolley Wagon approximates to the essentially Great Western *"Crocodile."*

HORNBY
RAILS, POINTS & CROSSINGS

PRODUCT of MECCANO LIMITED LIVERPOOL



Summer Days in the Garden!

Hornby Rails, Points and Crossings are designed to meet the most exacting requirements of model railway enthusiasts. They make possible an almost endless number of realistic and railway-like layouts. Only the finest materials are used in their manufacture. Gauge O.

Rails for Clockwork and Steam Trains

CURVED RAILS, 1-ft. radius

A1	Curved rails	per doz.	4/6
A1½	Curved half rails ...	,,	3/6
A1¼	Curved quarter rails...	,,	3/–
AB1	Curved brake rails ...	each	6d.
	2-ft. radius		
A2	Curved rails	per doz.	4/6
A2½	Curved half rails ...	,,	3/6
A2¼	Curved quarter rails...	,,	3/–
AB2	Curved brake rails ...	each	6d.
DC2	Curved rails, double track	½ doz.	7/6

STRAIGHT RAILS

B1	Straight rails	per doz.	4/–
B½	Straight half rails ...	,,	3/–
B¼	Straight quarter rails	,,	2/6
BB1	Straight brake rails ...	each	5d.
DS1	Straight rails, double track	½ doz.	6/6

DOUBLE SYMMETRICAL POINTS

	For 1-ft. radius curves		
DSR1	Double symmetrical points, right-hand	per pair	5/–
DSL1	Double symmetrical points, left-hand		
	For 2-ft. radius curves		
DSR2	Double symmetrical points, right-hand	per pair	5/–
DSL2	Double symmetrical points, left-hand		

PARALLEL POINTS

PPR2	Parallel points, right-hand	per pair	5/–
PPL2	Parallel points, left-hand		

CROSSINGS

CA1	Acute-angle crossings (for 1-ft. radius tracks) ...	each	2/–
CA2	Acute-angle crossings (for 2-ft. radius tracks) ...	,,	1/9
CR1	Right-angle crossings (for 1-ft. radius tracks) ...	,,	2/–
CR2	Right-angle crossings (for 2-ft. radius tracks) ...	,,	1/9

CROSSOVER POINTS

COR2	Crossover points, right-hand	per pair	12/–
COL2	Crossover points, left-hand		

POINTS

	1-ft. radius		
PR1	Right-hand points	per pair	4/–
PL1	Left-hand points		
	2-ft. radius		
PR2	Right-hand points... ...	per pair	4/–
PL2	Left-hand points		
PSR2	Points on solid base, right-hand	per pair	8/6
PSL2	Points on solid base, left-hand		

Rails for Electric Trains

CURVED RAILS, 1-ft. radius

EA1	Curved rails	per doz.	6/6
EA1½	Curved half rails ...	,,	4/6
EA1¼	Curved quarter rails...	,,	4/–
	2-ft. radius		
EA2	Curved rails	per doz.	6/6
EA2½	Curved half rails ...	,,	4/6
EA2¼	Curved quarter rails...	,	4/–

STRAIGHT RAILS

EB1	Straight rails	per doz.	6/–
EB½	Straight half rails ...	,,	4/6
EB¼	Straight quarter rails	,,	4/–

CROSSINGS

ECA	Acute-angle crossings	each	4/–
ECR	Right-angle crossings	,,	4/–

POINTS For 2-ft. radius curves

EPR2	Right-hand points... ...	per pair	7/6
EPL2	Left-hand points		

DOUBLE SYMMETRICAL POINTS

	For 2-ft. radius curves		
EDSR2	Double symmetrical points, right-hand	per pair	8/6
EDSL2	Double symmetrical points, left-hand		

PARALLEL POINTS

	For 2-ft. radius curves		
EPPR2	Parallel points, right-hand	per pair	8/6
EPPL2	Parallel points, left-hand		

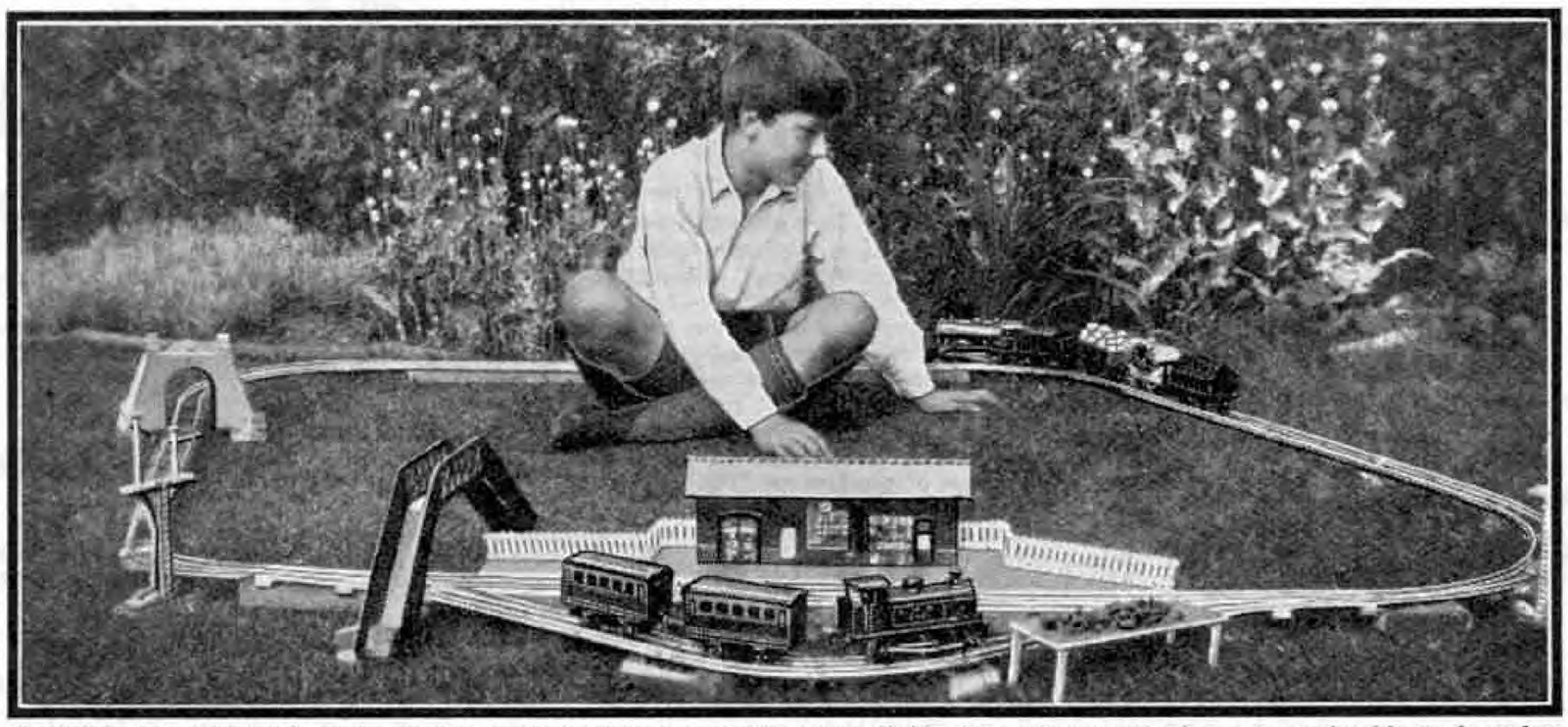
MECCANO LIMITED – BINNS ROAD – LIVERPOOL 13

Hornby Trains in the Garden

Some Hints on a Summer Pastime

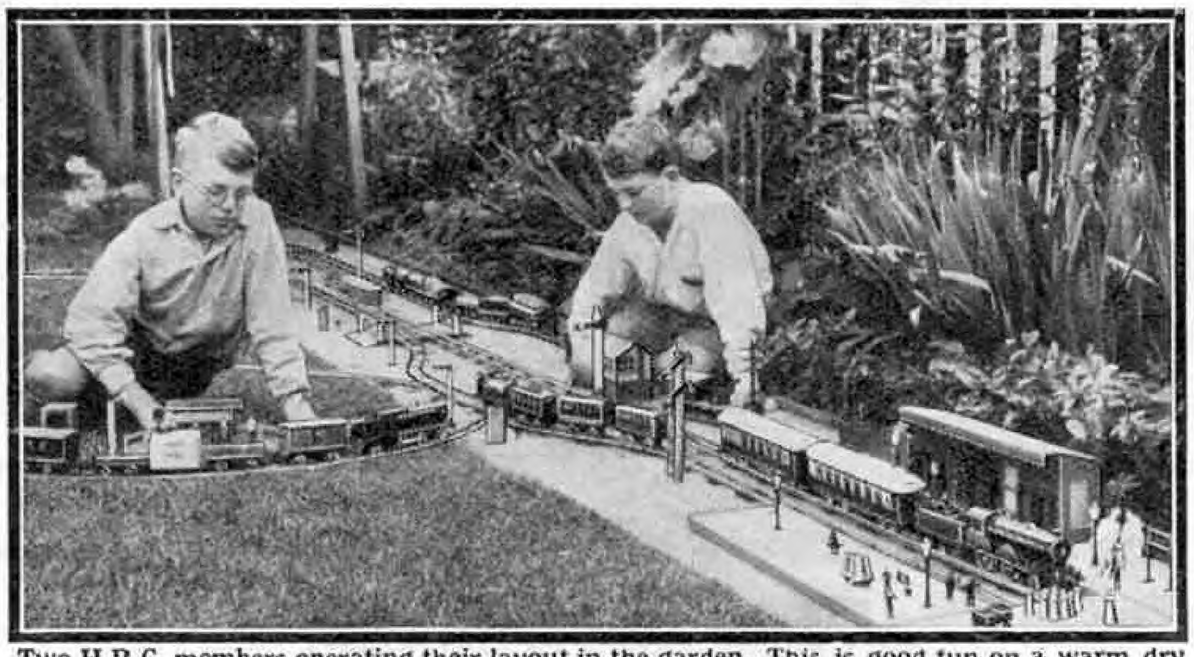
ON a fine summer day it is very tempting to take a Hornby railway out into the garden and enjoy railway operations in the fresh air and sunshine. We receive many enquiries at this time of the year as to whether it is wise to take Hornby track out of doors, and the object of this short article is to provide a general reply to such queries.

First of all it must be said quite definitely that the Hornby system is designed for indoor use, and is quite unsuitable for permanent outdoor layouts. Exposure to wet or damp, even for a very short period, would cause the track to rust, with disastrous effects on points and serious depreciation of the railway in general. It would be very unwise to leave the track out for even a single night in this country.



A simple but effective layout operated by M. Richardson of Wanstead, E.11. The rails are raised up on wooden blocks in order to clear the grass, the length of which might impede the running of the trains.

On the other hand it is quite practicable to lay down a line for a few hours on a dry sunny day; but the whole of the material must be packed up and taken in again when finished with, the rails and other track components being carefully wiped over before they are put away. If the track should happen to be caught in a sudden shower this wiping must be done with particular care. The locomotives and rolling stock also should be dried carefully. Apart from the danger of rust, the only trouble that is likely to be experienced arises from sand or grit finding its way into the mechanism of the locomotives. If there is any reason to suspect grit the mechanism should be washed clean with a brush moistened with paraffin or petrol, and afterwards lubricated with Meccano Oil.



Two H.R.C. members operating their layout in the garden. This is good fun on a warm dry day but the railway must not be left out all night.

The great fun about a railway in the garden lies in the ample space available and in the possibilities for arranging realistic surroundings. In almost any garden something can be done in the way of making cuttings and embankments, and even tunnels. The line may be carried over small valleys by means of viaducts improvised from pieces of plank, or by simple girder bridges built from Meccano. Perhaps the most successful tunnel is made from an old drain pipe sunk into a trough and covered with earth.

A stretch of level lawn naturally suggests itself as a suitable site for the layout, but as a matter of fact it is far from an ideal situation unless the grass is very short. If it is found that the grass is too long to admit of the rails being laid down satisfactorily, the difficulty may be overcome by raising the whole track above the grass by means of wooden blocks or small pieces of wood. The upper photograph on this page shows an arrangement of this kind.

As an alternative to the lawn, any level path or tiled walk may be brought into service. The lower photograph shows an interesting path layout, with a portion of the lawn made use of to provide space for a large circle of rails. A long single line run is very effective on a path, especially if matters can be arranged so that at certain points the trains disappear momentarily behind bushes or other obstacles.

Perhaps the greatest drawback to using a Hornby train in the garden is the amount of time taken up in laying out the track and accessories, and subsequently collecting them and bringing them indoors again. This disadvantage has led many readers to adopt a scheme that we have often recommended, namely to fix the rails to suitable wooden baseboards arranged in sections. The advantage of this arrangement is that, instead of a large number of individual rails, points and other items having to be handled separately, there are only a few sections to be dealt with as complete units. Many readers use this sectional baseboard system for their indoor railways, and in such cases the transferring of the layout to the garden is quite a simple matter. The baseboard scheme may be carried still further by arranging the whole layout, including stations and all accessories, permanently on a wooden foundation. The parts are thus kept from contact with the ground.

MECCANO

DINKY TOYS









Meccano Dinky Toys No. 1
STATION STAFF

No. 1a Station Master	each 3d.
No. 1b Guard	,, 3d.
No. 1c Ticket Collector	,, 3d.
No. 1d Driver	,, 3d.
No. 1e Porter with bags	,, 3d.
No. 1f Porter	,, 3d.

Price of complete set 1/6

Meccano Dinky Toys No. 4
ENGINEERING STAFF

No. 4a Electrician	each 3d.
No. 4b Fitters	,, 3d.
No. 4c Storekeeper ...	,, 3d.
No. 4d Greaser	,, 3d.
No. 4e Engine Room Attendant	,, 3d.

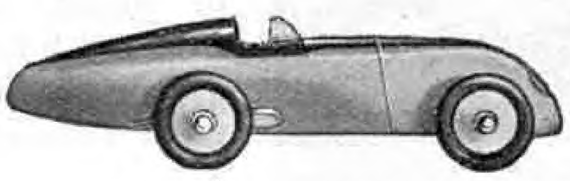
Price of complete set 1/6



Meccano Dinky Toys No. 3
PASSENGERS

No. 3a Woman and Child	each 3d.
No. 3b Business Man	,, 3d.
No. 3c Male Hiker	,, 3d.
No. 3d Female Hiker	,, 3d.
No. 3e Newsboy	,, 3d.
No. 3f Woman	,, 3d.

Price of complete set 1/6



Meccano Dinky Toys No. 23
RACING CAR
Assorted Colours. Fitted with rubber tyres.
Price 6d. each

Boys, Meccano Dinky Toys are the most realistic and the most attractive models in miniature ever produced. They are made of the best material obtainable, and are all finished in beautiful colours.

Many of these toys are ideal for giving the finishing touch to your model railways. You must have railwaymen to deal with your trains, and passengers to travel in them; car attendants to look after the passengers, and engineers for the maintenance of the railway and its equipment. You want farmyard animals for lineside fields, and you should have at least one of the famous "Hall's Distemper" advertisements alongside your line!

Then there are the miniature train sets, rail autocar and various other types of motor vehicle. You can have hours of fun running these on the table or on the floor, arranging road and rail transport services from one point to another.

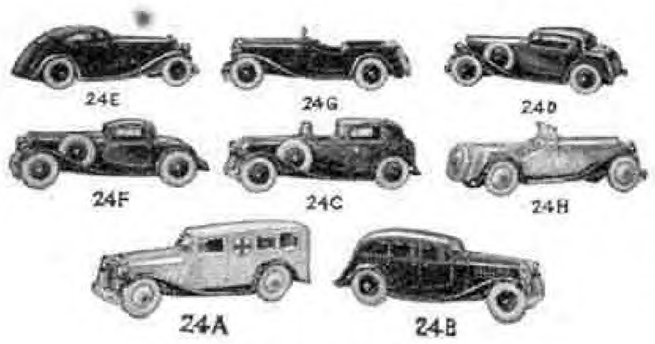
These splendid toys may all be purchased separately at the prices shown, or they may be obtained in complete sets. Ask your dealer to show you the complete range of Meccano Dinky Toys.



Meccano Dinky Toys No. 6
SHEPHERD SET

No. 6a Shepherd	each 3d.
No. 6b Dog	,, 3d.
No. 2d. Sheep	,, 2d.

Price of complete set 1/2



Meccano Dinky Toys No. 24
MOTOR CARS
Fitted with rubber tyres and silver plated radiators.

No. 24a Ambulance	each 9d.
No. 24b Limousine	,, 9d.
No. 24c Town Sedan	,, 1/-
No. 24d Vogue Saloon	,, 9d.
No. 24e Super Streamline Saloon ...	,, 9d.
No. 24f Sportsman's Coupé	,, 9d.
No. 24g Sports Tourer (4 seater) ...	,, 1/-
No. 24h Sports Tourer (2 seater) ...	,, 1/-

Price of complete set 6/6



Meccano Dinky Toys No. 19
MIXED GOODS TRAIN SET

No. 21a Tank Locomotive	each 9d.
No. 21b Wagon	,, 4d.
No. 21d Petrol Tank Wagon	,, 6d.
No. 21e Lumber Wagon	,, 5d.

Price of complete set 1/11



Meccano Dinky Toys No. 20
PASSENGER TRAIN SET

No. 21a Tank Locomotive	each 9d.
No. 20a Coaches	,, 7d.
No. 20b Guard's Van	,, 7d.

Price of complete set 2/6

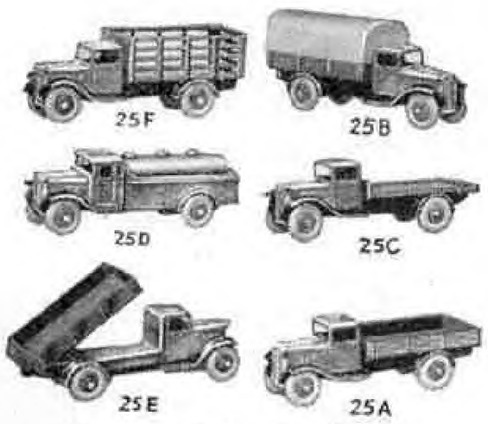


Meccano Dinky Toys No. 18
GOODS TRAIN SET

No. 21a Tank Locomotive	each 9d.
No. 21b Wagons	,, 4d.

Price of complete set 1/9

Meccano Dinky Toys No. 26
RAIL AUTOCAR
Assorted Colours ... ... Price 6d. each



Meccano Dinky Toys No. 25
COMMERCIAL MOTOR VEHICLES
Fitted with rubber tyres and silver plated radiators.

No. 25a Wagon	each 9d.
No. 25b Covered Van	,, 9d.
No. 25c Flat Truck	,, 9d.
No. 25d Petrol Tank Wagon	,, 9d.
No. 25e Tipping Wagon...	,, 9d.
No. 25f Market Gardener's Van ...	,, 9d.

Price of complete set 4/6



Meccano Dinky Toys No. 2
FARMYARD ANIMALS

No. 2a Horse each 3½d.	No. 2c Pig each 2d.
No. 2b Cow ,, 3½d.	No. 2d Sheep ,, 2d.

Price of complete set 1/6



Meccano Dinky Toys No. 22
MOTOR VEHICLES

No. 22a Sports Car each 6d.	No. 22d Delivery Van each 6d.
No. 22b Sports Coupé ,, 6d.	No. 22e Tractor ... ,, 9d.
No. 22c Motor Truck ,, 6d.	No. 22f Tank ... ,, 1/-

Price of complete set 3/9

Meccano Dinky Toys No. 13
HALL'S DISTEMPER ADVERTISEMENT
This miniature of a well-known line-side advertisement is intended to be placed in the fields adjoining the railway track. Price 9d.

Meccano Dinky Toys No. 28/1
DELIVERY VANS

No. 28c Manchester Guardian Van ...	each 6d.
No. 28f Palethorpe's Sausage Van ...	,, 6d.
No. 28a Hornby Train Van	,, 6d.
No. 28b Pickford's Removals Van ...	,, 6d.
No. 28d Oxo Van	,, 6d.
No. 28l Ensign Cameras' Van	,, 6d.

Price of complete set 3/-

Meccano Dinky Toys No. 28/2
DELIVERY VANS

No. 28g Kodak Cameras' Van	each 6d.
No. 28h Sharp's Van	,, 6d.
No. 28l Crawford's Biscuit Van ...	,, 6d.
No. 28m Wakefield's Oil Van	,, 6d.
No. 28k Marsh and Baxter's Van ...	,, 6d.
No. 22d Meccano Van	,, 6d.

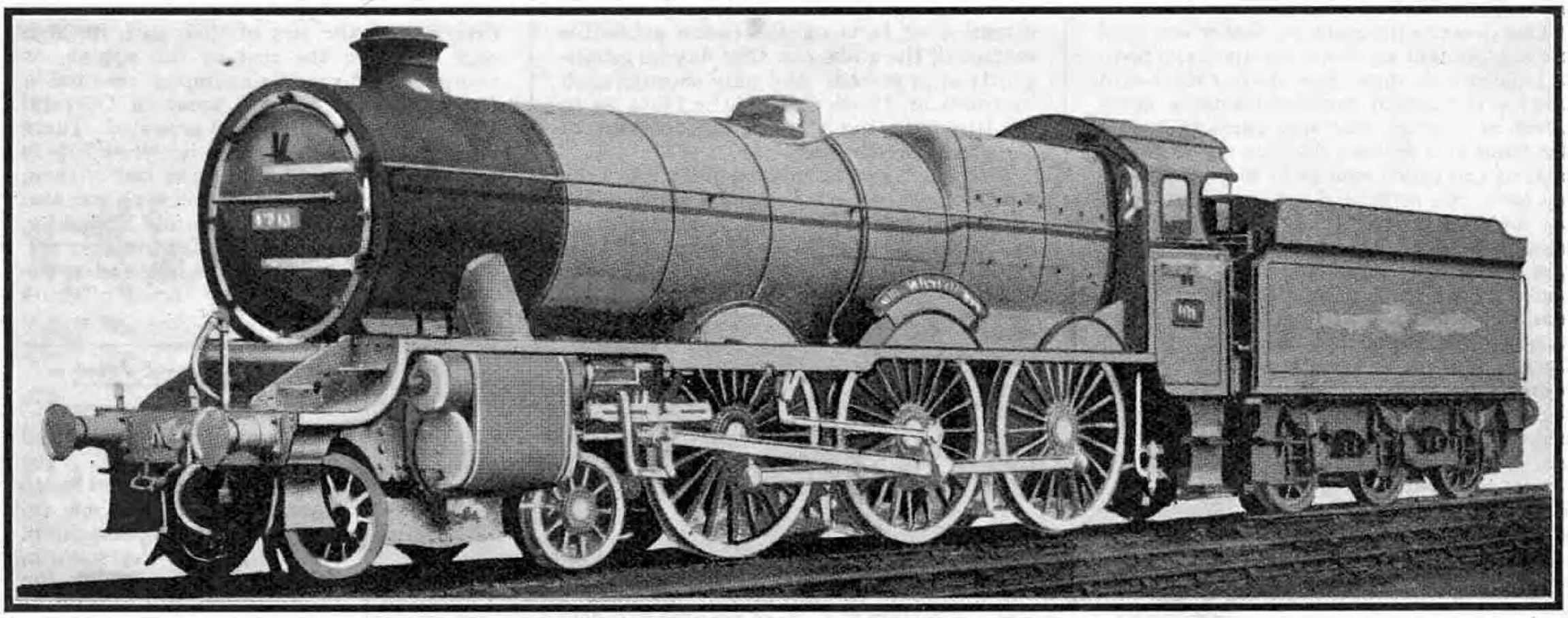
Price of complete set 3/-

MANUFACTURED BY MECCANO LTD., LIVERPOOL 13

H.R.C. COMPETITION PAGE

Competitions appearing on this page are open only to members of the Hornby Railway Company. Envelopes containing entries should have the title of the competition clearly written in the top left-hand corner and should be addressed to Meccano Ltd., Binns Road, Liverpool 13. The name, address and membership number of each competitor should appear in clear writing on every sheet of paper used.

A LOCOMOTIVE "MIXTURE" CONTEST



The most powerful and certainly the most graceful of British 4–6–0 express passenger locomotives are the G.W.R. "Kings." All our readers are familiar with these fine locomotives, either from actual inspection or from photographs, and this month we give them an opportunity of testing the extent of their knowledge.

The illustration on this page shows a "King" class locomotive that has been altered in design by taking away certain of its prominent parts and fittings and substituting similar ones from other well-known classes of locomotives. The problem is to show how the composite locomotive has been built up.

Readers are required to make a list of the parts that have been taken away from the locomotive, and to name the class of locomotive from which the substituted part has been obtained. No further details regarding the parts or fittings concerned are necessary.

The Contest will be divided as usual into two sections, Home and Overseas. To the four competitors in each section who send in the most complete lists of substituted parts will be awarded respectively in order of merit Hornby goods (or Meccano products if preferred) to the value of 21/–, 15/–, 10/6 and 5/–. In the event of two or more competitors sending in lists of equal accuracy and completeness, the prize will be awarded to the neatest or most originally displayed entry.

All entries for this contest must be from H.R.C. members, and must be marked with the senders' membership numbers.

Envelopes containing entries should be marked "*H.R.C. August Locomotive Contest.*" Entries from Home competitors must be posted to reach Meccano Ltd., Binns Road, Liverpool 13, by 31st August. The closing date for the Overseas Section is 30th November.

Railway Photographic Contest

Continuing the series of Railway Photographic Contests announced in April, we announce this month another similar contest. There are no restrictions with regard to the subject chosen, and the only rule is that each competitor must be an H.R.C. member, and that the actual exposure must have been made by himself, although the developing and printing may be the work of a professional.

Prizes of Hornby Train or Meccano goods to the value of 21/–, 15/–, 10/6 and 5/– respectively will be awarded in each Section, Home and Overseas. Envelopes containing entries should be marked "*H.R.C. August Photographic Contest,*" and posted to reach Meccano Ltd., Binns Road, Liverpool 13, not later than 31st August. The closing date for the Overseas Section is 30th November.

Drawing Contest

These contests in which competitors are required to sketch railway officials performing one of their daily duties continue to be very popular. The subject we have chosen this month is "*The Stationmaster.*" He may be in charge of an important main line station, or of a village station on a branch line.

To the senders of the four best drawings submitted in each Section, Home and Overseas, prizes will be awarded consisting of Hornby Train goods (or Meccano products if preferred) to the value of 21/–, 15/–, 10/6 and 5/– respectively. In the case of a tie the prize money will be equally divided.

Envelopes containing entries must be marked "*H.R.C. August Drawing Contest*" in the top left-hand corner, and posted to reach Meccano Ltd., Binns Road, Liverpool 13, by 31st August. The closing date for the Overseas Section is 30th November.

COMPETITION RESULTS

HOME

May "Picture Puzzle Contest."—First and Second (Tie): R. C. Forrest (18603), Ilford, and J. Macken (23826), Bromley. Third: C. E. Wrayford (6039), Moretonhampstead, Devon. Fourth: J. C. Button (10335), Crewe.

May "Railway Photographic Contest."—First: S. Garbutt (30122), Altrincham. Second: J. R. Sleightholme (17091), York. Third: W. F. Lever (24206), Penylan, Cardiff. Fourth: A. F. Pegler (15624), Lound, Nr. Retford.

May "Railway Drawing Contest."—First: K. Costain (5108), Bolton. Second: R. C. T. Lyle (30157), Tupsley, Hereford. Third: H. Dixon (34165), Huntington. Fourth: A. Marsh (20196), Kates Hill, Dudley.

OVERSEAS

February "Loco Feature Contest."—First: D. Parker (38595), North Battleford, Sask., Canada. Second: F. G. Eagle (28845), Byculla, Bombay. Third and Fourth (Tie): M. Bosch (34964), Holland, and F. L. Bingen (28995), Holland.

February "Voting Contest."—First: R. Garcia (23445), San Juan, Trinidad. Second: D. Murison (37642), Buenos Aires, Argentine. Third: J. A. Rodriguez (3647), Montreal. Fourth: J. A. Coates (23863), Quebec.

Windjammer Days—(*Continued from page 603*)

foremasts hands, a rough-and-ready lot, I cannot tell. I have no doubt, however, that Father Neptune refused to let them go at the end of that voyage. It is easy to picture what probably happened when they went ashore with their hard-earned wages—perhaps, a brightly lit saloon on Paradise Street, a few drinks, and stories of other tall ships, sufficed to lure them down to the sea again. When salt gets into a man's blood his feet will always itch.

One dreary afternoon my father wrapped me in a blanket and took me up to the poop to look at a strange vessel on our starboard bow, a homeward bounder under a great cloud of canvas. She was running before the wind and making dashing speed as she heaved and rolled past us in those tremendous seas. She presented a magnificent sight, the memory of which may never be erased from my mind. My father passed a line round my waist and lashed me to the rail under the lee of the dripping weather cloth. Then he focussed his binoculars on the stranger—a Yankee, the beautiful *Tam-O-Shanter!* She looked like an enormous seabird with her great spread of canvas bellying out almost to bursting point. Sometimes her shapely bow would rise high out of the water and her bowsprit would point towards the sombre heavens; then down she would rush into a yawning gulley, as though bent on disappearing forever beneath the vast tumbling ocean. A flock of Cape pigeons following in her wake lent to the unique scene an aspect of inexpressible wildness. Soon she disappeared from our sight when a heavy sleet laden squall blanketed the deep.

The *"British Isles"* continued to headreach to the west'ard for many days. Then at last came the welcome slant in the shape of a bitter southerly gale. We had doubled Cape Horn! Dim memories of finer weather pass like a panorama across my mind. My mother sat on a deck chair on the poop. Wo Ken's heart was lightened by the advent of a warmer sun; he went about his work singing in his native tongue, and seemed to delight in his culinary ability now that the galley was dry. "What you likee, Klapitan?" he would chuckle. "You likee roly-poly, you likee plum duff?—fine and dlandy, me go fixee!"

The apprentices spent the dog watches singing songs of home—"John Peel," "Alice Ben Bolt," "Annie Laurie," and "Clementine." The foremast hands too were glad that bad weather had been left astern. Some of them vowed that never again would they sit astride a weather yardarm and haul out the reef earring; at the end of the voyage they would quit the sea forever and perhaps raise chickens. All sailors seem to have a touching weakness for chickens. However, it is a foregone conclusion that those same men never renounced their allegiance to the god of the sea.

At last the *"British Isles"* arrived in the port of Callao. I saw Cape Horn waters possibly for the last time in 1919 while making a voyage from Sydney to Queenstown for orders in the ship *"Tamar."*

My father is evidently destined to remain afloat for some time yet, as he now commands the last of America's windjammers, *"Tusitala."*

This interesting article is reprinted from *"The Grace Log"* by courtesy of the Editor.

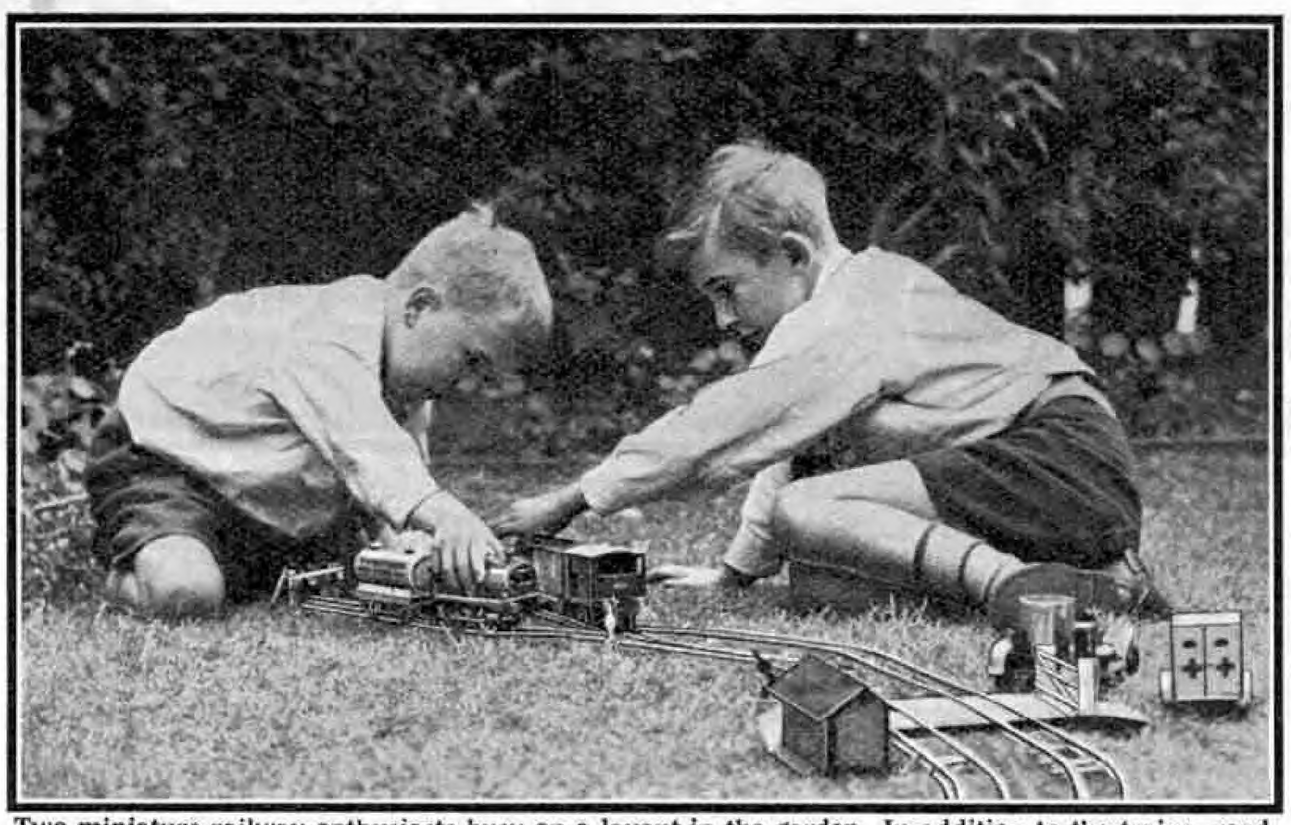
Studying Earth's Magnetism—(*C. from p. 605*)

well as in declination, that scientists are working toward the day when the origin and behaviour of the Earth's magnetism may be well understood. Only through the never-ending systematic acquisition and digestion of facts on the entire accessible surface of the globe can that day be intelligently approached. And only through such journeys as Hanson's can the facts as to conditions in the more remote corners of the world be acquired.

This one trip was only a small part of the whole great programme of scientific exploration carried on by the Department of Terrestrial Magnetism. Some 200 land expeditions have been sent into the far corners of the world in the past three decades, to gather their treasure of geophysical facts. The Institution's non-magnetic, specially designed vessel *"Carnegie"* sailed 342,681 miles over all the oceans from 80° north to 61° south, securing magnetic data before she was destroyed by fire in November 1929. The *"Galilee"* before her travelled 73,511 miles during three years, doing similar work. Two observatories, one at Huancayo, Peru, and the other at Watheroo, Australia, are maintained by the Institution through the Department of Terrestrial Magnetism to record the behaviour of the three magnetic elements, day and night, year in and year out.

Such is the Carnegie Institution's part in the world offensive that is taking place to-day on "What causes the Earth's magnetism and why its many progressive, regular, and irregular changes?"

We are indebted to the courtesy of the Carnegie Institution of Washington for the information in this article.



Two miniature railway enthusiasts busy on a layout in the garden. In addition to the trains, road traffic is not neglected, as the level crossing and motor vehicles near it show.

Old London Tank Engines—(*C. from page 627*)

There was one exception, however, which received the smaller cylinders and link motion intended for a standard goods engine, the latter getting the cylinders and Joy's gear originally destined for the tank. Later engines followed the design of the exception mentioned, and of these the upper illustration on page 627 shows No. 798 of this modified class. The earlier engines with Joy's gear were known as "Gobblers," owing to their immoderate appetite for fuel, and were altered in later years to conform to the modified design. No further developments of these radial tanks took place until this century, when in the latest examples higher-pressure boilers were applied, and copper-capped chimneys, as in more recent Great Eastern practice, replaced the severe stove-pipe sported by No. 798. A roomy side-window cab of Great Eastern type was grafted on to the design, and the size of this, with its high roof dwarfing the rest of the engine, as compared with earlier examples, resulted in the application of the name of "Crystal Palaces" to the engines so provided. There were at one time over two hundred 2–4–2s on the Great Eastern, and the last of them were built in 1911. The 2–4–2 type was also used on the Lancashire and Yorkshire, North Eastern and Great Central systems, but these cannot be included under the heading of "London" tank engines.

Railway Coats-of-Arms—

(*Continued from page 633*)

Salisbury, Winchester and Portsmouth; and the London, Brighton and South Coast Railway device represents London, Brighton, Hastings and Portsmouth. The coat-of-arms of the South Eastern Railway displays the White Horse of Kent upon the St. George's Cross, above which is a demi-lion conjoined to a demi-ship—that is the front half of a lion joined to the stern half of a ship—representing the Cinque Ports. A castle representing Dover forms the crest. The supporters are a dragon-winged horse on the dexter hand, and a conjoined demi-lion and demi-fish on the sinister hand. The motto is "Onward." The London, Chatham and Dover Railway device displays four shields representing Kent, Dover, London and Rochester.

The emblem of the London, Midland and Scottish Railway bears a dragon's wing charged with a cross, the English rose and the Scottish thistle.

The Pullman Car Co. Ltd. have a striking and interesting coat-of-arms. On the "dexter chief" quarter of the shield are "three lions passant guardant, or, on a field gules," representing England; and on the "sinister chief" is "a lion rampant, gules, on a field or," representing Scotland. Ireland is represented on the "dexter base" by "a harp, or, on a field azure"; and Wales on the "sinister base" by "a dragon, gules, on a field or." The supporters are "two lions rampant, or."

The London Metropolitan Railway had formerly a coat-of-arms consisting of the arms of the city of London above a representation of two tunnel entrances. The coat-of-arms now in use also bears the arms of London, and the emblems of Buckinghamshire, Middlesex and Hertfordshire.

The coat-of-arms of the Cheshire Lines Railway, a line operated in pre-grouping days jointly by the Great Northern, Great Central and Midland railways, and now by the L.M.S.R. and the L.N.E.R., comprises the arms of the Great Northern, Great Central and Midland railways.



THE BURGLARS' GRATITUDE

The Managing Director, who had just returned from America, was full of the latest ideas. One of these was to put a notice on the door leading to his private office where the safe was kept, which read: "Notice to Burglars. As this board is fitted with modern burglar alarms, the police will be summoned instantly if it is touched."

Soon after this notice had been exhibited he arrived at work and found underneath it a second notice. "Thanks for the tip, we've broken through the wall instead."

* * * *

Grocer: "You want a pound of ochre? Is it red ochre for painting bricks?"

Small boy: "No, it's tappy ochre what ma makes her pudding with."

* * * *

Mother (to little son who has been untruthful): "Do you know what happens to little boys who tell lies?"

Sonny: "Yes, mother, they travel half fare."

* * * *

Jack: "See that man, he landed in this country with bare feet and now he has millions."

John: "By jove, he must be a centipede."

* * * *

Magistrate: "As regards the ownership of this eight-day clock, my decision is that the plaintiff gets the clock."

Defendant: "And what about me, your Honour?"

Magistrate: "You get the eight days."

* * * *

Captain (receiving new middy): "Well, my boy, the old story I suppose—fool of the family sent to sea?"

Middy: "Oh, no sir, that's all altered since your day."

* * * *

Sergeant: "What's the first thing you do when cleaning your rifle?"

Recruit: "Look at the number."

Sergeant: "Oh, and what's the great idea?"

Recruit: "To make sure I don't clean someone else's."

* * * *

John: "If you sit on a tack in winter time what is that a sign of?"

Jack: "I don't know."

John: "An early spring."

* * * *

FOOTBALLERS DON'T CARE



Mrs. Brown (seeing Rugby scrum for the first time): "Oh, isn't it terrible. Why, they'll kill that poor boy underneath."

Knowledgeable Daughter: "Don't be silly, mother. He doesn't mind it; he's unconscious by this time."

* * * *

Absent-Minded Professor: "My wallet has gone! Someone must have picked my pocket."

Wife: "Didn't you feel a hand in your pocket?"

Professor: "Yes, but I thought at the time that it was my own."

TIE-HANGING

The lights had gone out in the bus, and the tall man asked the young lady who had got on at the last stop if he could help her to find a strap.

"I've already found one," she replied.

"Then," he asked, "would you mind letting go of my necktie."

* * * *

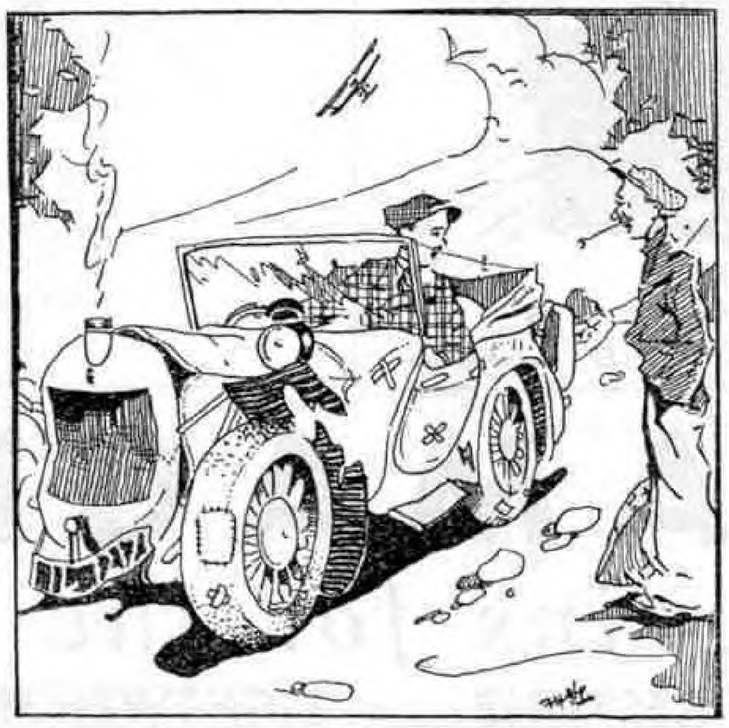
Smiling Sam: "I never worry."

Dismal Jimmy: "Never?"

Smiling Sam: "No. In the daytime I'm too busy and at night I'm too sleepy."

* * * *

JUDGED BY APPEARANCE



The ramshackle car drew up. "Can you tell me the quickest way to Slocombe?" asked its owner.

"Yes," replied the yokel, eyeing the car, "take a bus."

* * * *

Fond Mother (on liner): "I don't like the captain of this ship at all. I made the simple request just now that he should let Donald have a turn at the wheel, and he was positively snappy about it."

* * * *

The man with the vacuum cleaner was very persuasive and insisted on giving a demonstration. "But," protested the housewife, "I don't want a vacuum cleaner."

"Ah, madam," continued the traveller, "wait till you see how it works. Now let me give you a demonstration. First, I scatter a few ashes over your carpet and suite; then I strew this rubbish over the mat, so."

"I expect you to clean this awful mess up again," said the woman.

"Don't worry, I won't leave a speck. All we've got to do now is to plug in to your electric fixture."

"But you can't do that," said the housewife, "we have only gas here."

* * * *

Colonel (inspecting barracks): "Suppose the barracks caught fire, what order would you give?"

Sergeant: "Cease fire!"

* * * *

Sandy was learning to play the bagpipes. One night while he was parading about the room, skirling vigorously, his wife protested: "That's an awfu' noise ye're making."

Sandy sat down and removed his boots. He then got up and resumed his piping, in his stockinged feet.

* * * *

Teacher: "Can you tell me the name of any animal peculiar to Australia."

Sam: "The rhinoceros, sir."

Teacher :"Wrong. That animal is not found in Australia."

Sam: "Well, sir, that's exactly why it would be peculiar."

SHARING THE RISK

The rambler signalled to an overtaking car that he would like a lift.

"Delighted," said the motorist when he learned what was wanted. "The fact is this is the first time I've driven and I'm rather nervous. I shall be glad of somebody to talk to."

* * * *

George: "Why don't you advertise?"

Jack: "I did once and it nearly ruined me."

George: "How was that?"

Jack: "People came in and bought nearly all I had in the shop."

* * * *

The proprietor of a small restaurant prided himself on his cooking, and therefore was astonished one day to hear a customer severely criticising a pie. " My dear sir," he protested, "I made pies before you were born."

"O.K." replied the customer, "But why sell them now?"

* * * *

Farmer (to visitor from the city): "If things get too bad we can eat our forest preserves."

Visitor: "As for us, we can eat our traffic jams."

* * * *

Teacher: "Tommy, what is a fort?"

Tommy: "A place for soldiers."

Teacher: "Correct. Now Johnny, what is a fortress?"

Johnny: "A place for the soldiers' wives."

* * * *

Son: "Mother, may I go out with the other boys and look at the comet?"

Mother (cautiously): "Yes, Jimmy, but don't go to close."

* * * *

Father: "How is it that you are always at the bottom of the class?"

Willie: "It doesn't make any difference Pa, they teach the same things at both ends."

* * * *

DEGREES OF SAFETY



A young man from the city was crossing a large field. "Say," he called to the farmer in the next enclosure, "is that bull coming there safe?"

"Well," drawled the farmer, "I reckon he's a dashed sight safer than you are jist now."

* * * *

Teacher: "If I put 11 nuts in your hands, and you eat four, how many will you have?"

Pupil: "Eleven."

Teacher: "How can that be so, if you've eaten four?"

Pupil: "I'll have four inside and seven outside."

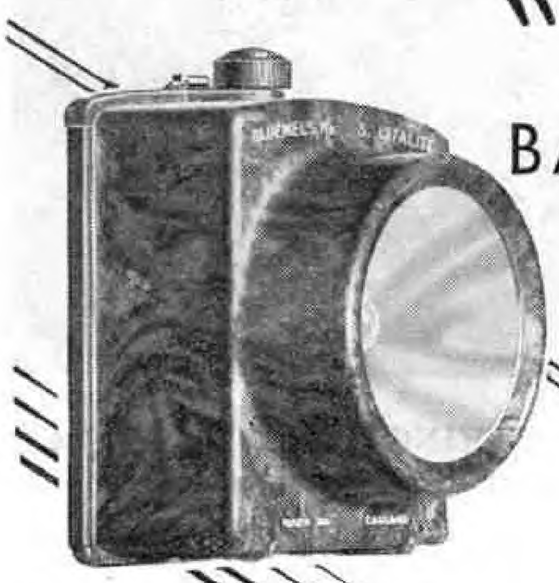
* * * *

Plumber (laying out his tools): "There, in spite of all the silly jokes about us, we've not forgotten a single thing. My mate's here with me, we've not got to go back for anything—"

Housemaid: "You've come to the wrong house."

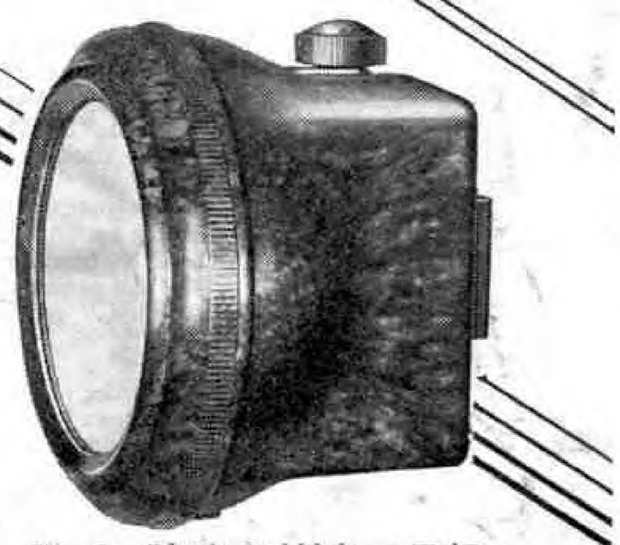
Bluemel's

"LITALITE" BATTERY LAMPS



- Special moulded body prevents corrosion or rust.
- Solid colours—cannot peel off.
- Long, powerful beam.

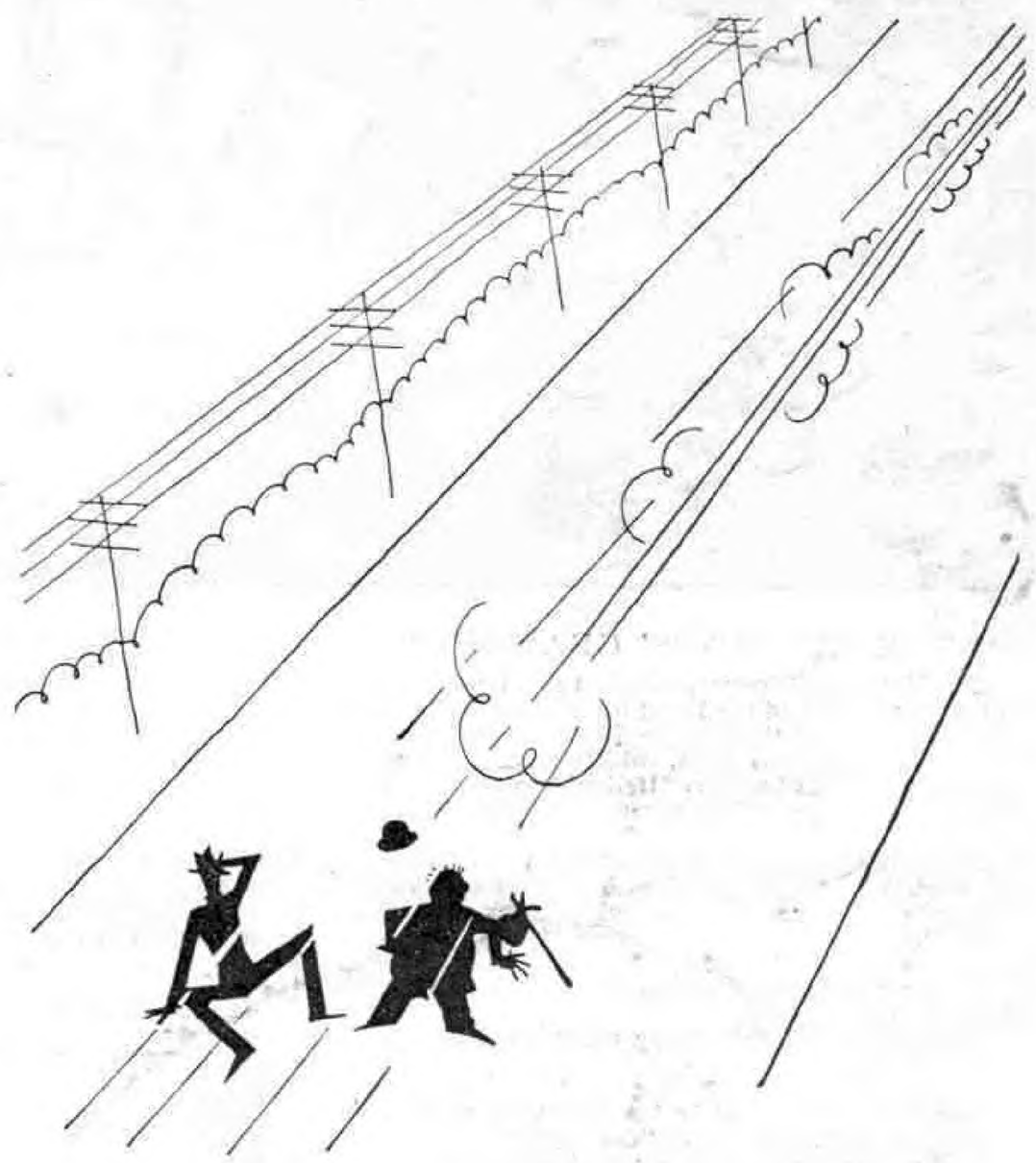
No. 3
In four Colours **3/6**
Ivory White **4/-**



No. 2 Black or Walnut **7/2**
Ivory White **7/8**

An interesting list packed with illustrations of useful cycle accessories is post free from Bluemel Bros. Ltd., Dept. 27, Wolston, nr. Coventry.

—always RIGHT IN FRONT



"If we only had a car we could overtake that fellow and tell him what we think of him—if we only had some Pratts High Test."

GAMAGES

Big Bargains for the Holidays

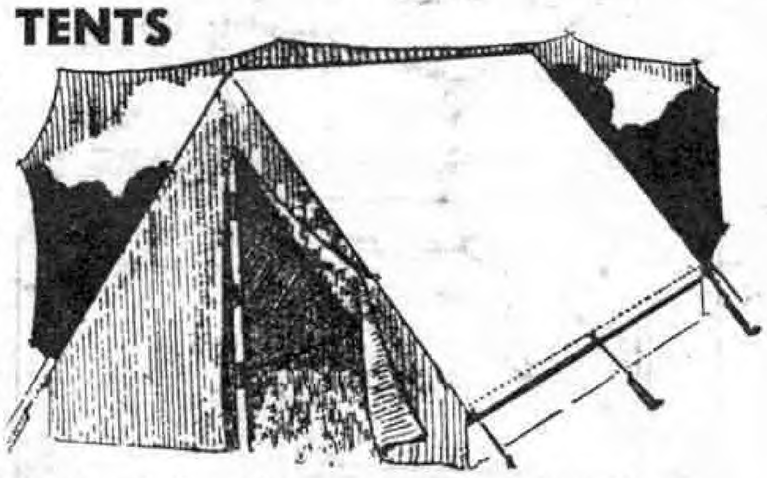


FIRESTONE AIR BUOY AT HALF PRICE

It's a fine, fat, buoyant tube, made by Firestone with the same care that they put into their famous tyres and inner tubes. Will easily support the weight of an Adult. It is gaily coloured Blue or Green. Takes a few seconds to inflate by mouth. For the seaside, swimming baths, etc. **Has no Dangerous Metal Valve.** Listed at 5/-. Gamages special price **2/6** All brand-new fresh stock. Post 6d.

LIGHTWEIGHT TENTS

Whether you are a hiking camper or a cycling camper you will find that you can save money on all your gear at Gamages. For instance, here is a really fine lightweight tent. It is correctly designed, well made, and represents the best tent value in the country. In White. Size 6 ft. x 4 ft. 6 ins. x 3 ft. 6 ins. high. Built with 6 in. walls, 3-piece jointed poles. Complete with pegs, lines, and runners. Packed in valise. Price **8/6** Carriage 1/-.

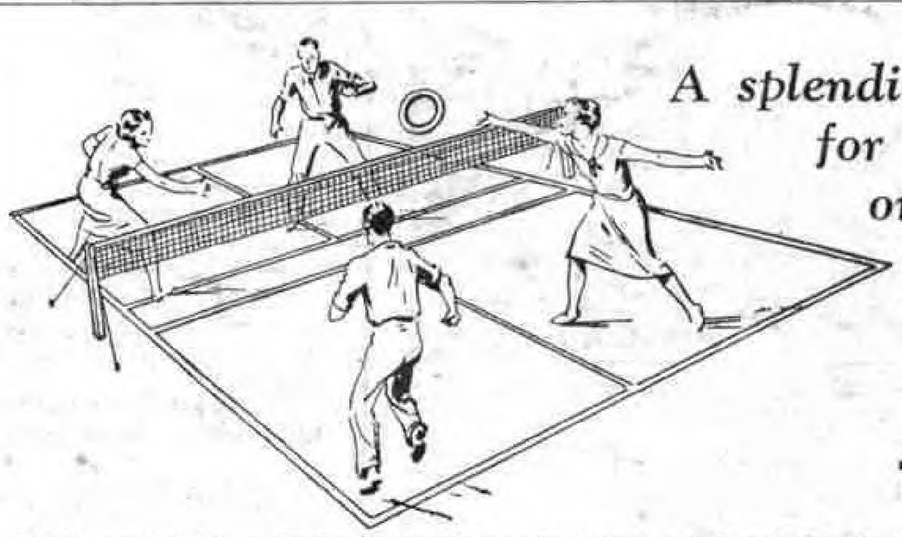


Send for Gamages Camping List

WONDERFUL BARGAIN IN RUBBER BOATS

Just the boat for your holidays and ideal for surf bathing. Made in exceptionally heavy rubber, in assorted colours. Towing rope attached. Note the large size—36 ins. long. Inflated in a jiffy. *Foreign.* Price only **5/-** Post 9d.



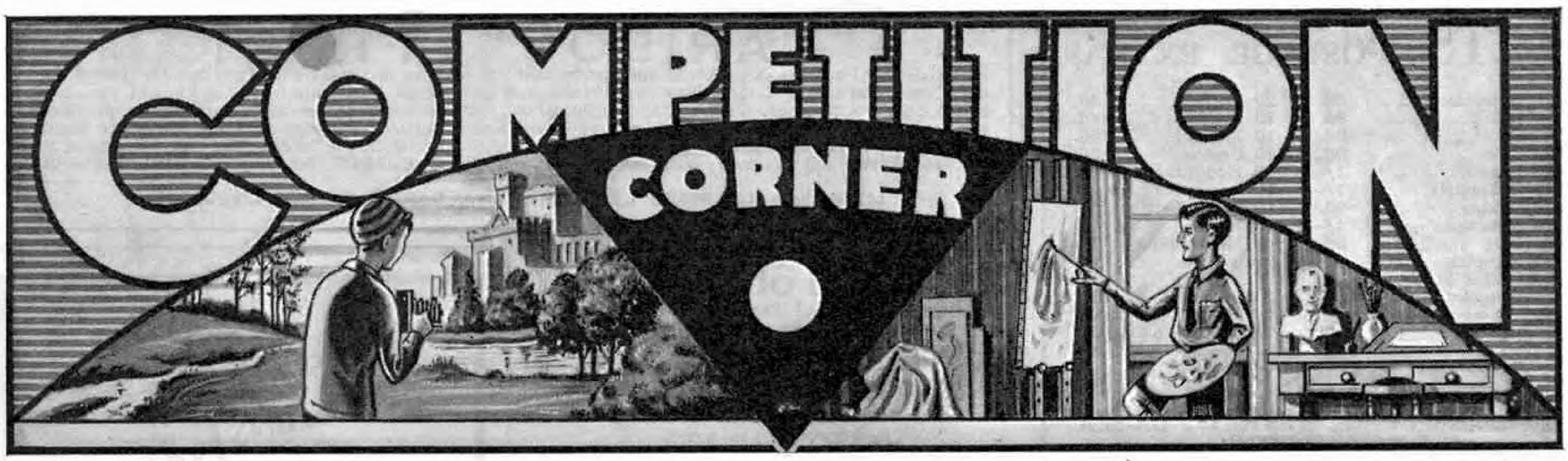


A splendid game for Garden or Beach

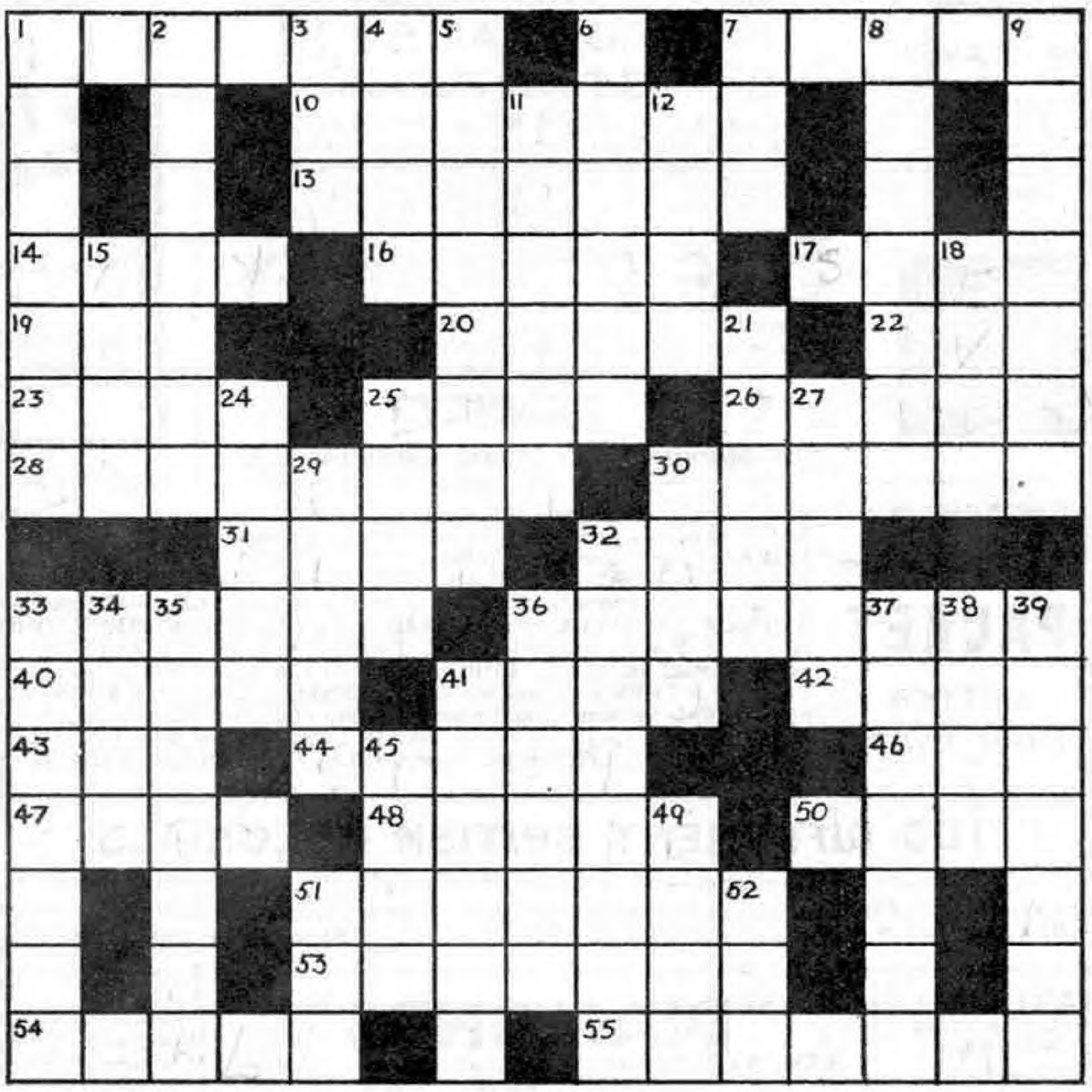
QUOIT OR RING TENNIS

The Set comprises pair of polished jointed poles, guy ropes and pegs. Steam tarred net with top band. Regulation size air-inflated rubber ring. Boxed, complete with Rules. Price **7/6** Post 9d.

GAMAGES, HOLBORN, LONDON, E.C.1
Telephone: Holborn 8484 *City Branch: 107, Cheapside, E.C.2*



AUGUST CROSSWORD PUZZLE



CLUES DOWN

1. Considers
2. Mixing Board
3. Sphere
4. Plant
5. Eatable
6. Portion of time
7. Animal
8. Pacify
9. An Asiatic Race
11. Drinking
12. Foreign coin
15. Wading bird
18. Level
21. Used
24. Weird
25. Sort
27. Nymph
29. Sorts
30. Crushed rock
32. Discerning
33. Distress
34. Support
35. Free
36. Tell
37. Weapon
38. Right
39. Nature
41. Competitors
45. Story
49. Strip
51. Peep
52. Custom

CLUES ACROSS

1. Infant
7. Urchins
10. Closes up again
13. Graces
14. Nest
16. Fools
17. Pretend
19. Dispose
20. Floor coverings
22. Prayer
23. Ceremony
25. Despatched
26. Acts
28. Polishing
30. Confident
31. Division
32. Clear
33. Piece of Wood
36. Available for renting
40. Tested
41. Split
42. Platform
43. Deprive
44. Prop
46. Affirms
47. Imitate
48. Use
50. Sharpen
51. Eminence
53. Softens
54. Outburst
55. Scene of action

August is certain to provide one or two wet days, and a crossword puzzle competition will provide our readers with a happy means of passing away rainy hours. The puzzle follows the style of the previous ones we have set on this page, in that every effort has been made to provide a puzzle free from annoying traps in the form of alternative solutions. The clues are all perfectly straightforward, and every word used can be found in Chambers' or any other standard dictionary. The rules that govern the solution of crossword puzzles are so well known that it is unnecessary to give any further explanation of the requirements of the competition.

The prizes will consist of Meccano or Hornby Train goods (to be chosen by the winners from the current catalogues) to the value of 21/–, 15/–, 10/6 and 5/– respectively, to be awarded to the senders of the four neatest or most novelly-prepared correct solutions, in order of merit. The prizes will be duplicated for the Overseas section, which is open to all readers living outside Great Britain, Ireland and the Channel Islands.

Entries should be addressed " August Crossword Puzzle, Meccano Magazine, Binns Road, Liverpool 13," and must be sent to reach this office not later than 31st August. Overseas closing date, 30th November.

Competitors should not mutilate their magazines by cutting out the crossword illustration. Instead they should make a copy of the square on the same scale, or larger, and use that for the Contest.

August Photo Contest

Our photographic competition this month is open to photographs of any subject and size, made with any make of camera, plate, film or paper. Entries may be professionally developed and printed, but the exposure must have been made by the competitor.

The entries will be divided into two groups, Home and Overseas, and in each of these groups there will be two sections, A for those aged 16 and over, B for those under 16. Prizes of Meccano Products or Photographic Materials to the value of 21/– and 10/6 will be awarded in each section. In the judging, all other things being equal, preference will be given to entries that are the competitor's own work throughout.

Entries must be addressed " August Photo Contest, Meccano Magazine, Binns Road, Liverpool 13." Closing date, 31st August. Overseas, 30th November.

Unsuccessful entries will be returned if a stamped addressed cover is enclosed.

COMPETITION RESULTS

HOME

June Photo.—First Prizes: Section A, J. L. Rice (Northampton); Section B, A. F. Pegler (Lound, Notts.). Second Prizes: Section A, F. H. Culverhouse (Sheffield); Section B, P. T. Clarke (East Sheen, S.W.14).

Improbabilities.—1. R. W. Lyon (Cardiff); 2. W. R. D. Saxton (Middlesbrough); 3. E. B. Simpson (Derby); 4. A. Griffiths (Lewes).

OVERSEAS

Slogan Contest.—1. L. Sanh (Hong Kong); 2. R. Garcia (Trinidad); 3. J. A. Coates (Quebec); 4. E. Middleton (Oamaru, N.Z.).

SETS (POSTAGE EXTRA)

20	Argentine ...	8d.	20	Dantzig ...	4d.
20	Brazil	9d.	10	Esthonia ...	4d.
20	Chili	9d.	10	Finland ...	2d.
20	Cuba	9d.	10	Greece ...	2d.
20	Ecuador ...	1/-	10	Honduras ...	5d.
20	Guatemala ...	1/-	10	Luxemburg ...	4d.
20	Mexico ...	9d.	10	Liechtenstein	2d.
20	Nicaragua ...	1/-	10	Malta ...	4d.
20	Peru	9d.	10	Mozambique...	4d.
20	Salvador ...	1/-	20	Austria ...	2d.
20	United States	4d.	20	Belgium ...	2d.
10	Uruguay ...	5d.	20	Czecho ...	2d.
10	Venezuela ...	5d.	20	Poland ...	2d.
10	Victoria ...	4d.	20	Switzerland ...	2d.

J. RUSSELL

23, Shanklin Drive, WESTCLIFF-ON-SEA

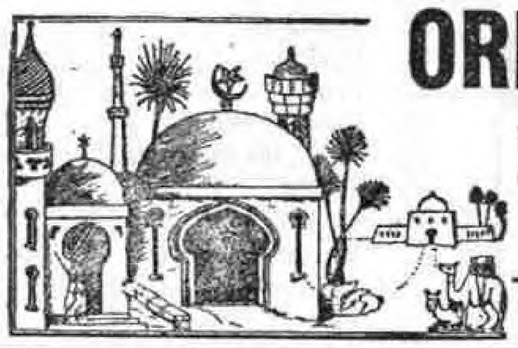
FREE! TO STAMP COLLECTORS

I will send this splendid packet to all Stamp collectors sending 2d. postage only.

G. P. KEEF, Willingdon, Eastbourne.

20 STAMPS all different, from the French Colonies, showing natives, leopards, jungle scenes, etc. Handsome Pictures.





ORIENTAL PACKET

BETTER THAN EVER!

Once again I am offering this wonderful packet. It contains more stamps than ever. **35** fine Orientals with mosques, minarettes, domes and eastern views. Set of **EGYPT, SYRIA** (pictorial), set of **4 TUNIS,** a fine new issue **LATAKIA,** set of **PALESTINE** (mosque, etc.), **AFGHANISTAN** (new issue), set of **FRENCH MOROCCO** (Arab buildings, fine pictorials), **2 SOMALILAND** (new issue), **GRAND LIBAN,** set of unused **ALGERIA,** fine **MECCA,** pictorial **IRAQ,** and a wonderful set of **10 TURKEY,** including pictorials, towers, minarettes, etc. (usually sold at 1/-. Price **4½d.** Postage **2d.** extra, abroad **3d.** extra). **PURCHASERS** of this packet asking for approval sheets will receive **FREE** a unique set of **10 PERSIA,** usual price **1/6.** Money returned if not satisfied. Senders of addresses of stamp collecting friends receive an additional set **FREE.** BARGAIN OFFERS: **20 AIR POST 6d., 100 BRITISH COLONIALS 1/-.**

H. C. WATKINS (M. Dept.), GRANVILLE ROAD, BARNET.

10 PERSIA FREE



"CARIBOU" FREE!

Pictorials and Portraits. A packet of fine stamps that will intrigue and thrill you. They include stamps from the Oceanic Continent, Victoria, New South Wales, and Queensland. Europeans including Finland, Hivatalos, and Bohemia. Americans—Uruguay, Venezuela, Brazil, and also one of the beautiful Caribou stamps. Grand sets, unique Epirus (soldier), a stamp from wild Syria and an adjacent country depicting one of the world's wonders. A large Airmail stamp, and finally a further splendid collection of 50 different varieties. One of the most remarkable and excellent packets we have ever put together. FREE. Just send 2d. postage requesting approvals.

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(Collections purchased.)

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A new set of Pictorial Stamps from this British possession sent free of charge to bona-fide applicants for selections of duplicates on approval. Extra Mystery **PACKET** of 450 (approx.) unpicked stamps post free 8d. 5 Ivory Coast pictorials, new issue. Post free 4½d. 16 Eng. Revenue stamps 1/- to 15/-. Post free 3d.

HENRY TURNER,

110, BARNETT ROAD, BRIGHTON, SUSSEX.

NYASSA TRIANGLES!
EGYPT AIR MAILS!!
PICTORIALS!!!
80 STAMPS 6d.

Including set of unused **Nyassa Triangles.** Set of **Egypt 1933 Air Mails** showing Aeroplane flying over Pyramids. Eight interesting **African British Colonials** catalogued at 5/1. Seven **Canada** including Ottawa Conference issue. Large **Belgium Piccard Balloon Commemorative** stamp. Other stamps include used **Roumania 1931 Air Mails** showing Monoplane, unused Air Mails, surcharged issues and pictorials. **Price 6d.** (Postage 1½d. extra). Money and postage will be returned if not satisfactory. We have numerous other offers at low prices. Hundreds of unsolicited testimonials have been received.

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GIBBONS STAMP MONTHLY

Price **4d.** Post Free.

Send for this Month's No. to Dept. S.15, 391 Strand, W.C.2.

★ G.S.M. only costs 3/- for a year's post free subscription.

FREE! **100 DIFFERENT BRITISH COLONIALS** **FREE!**

This wonderful offer of the World's most popular stamps, from most of the colonies of our Empire, includes pictorials, commemoratives, high values. Bird, ship and animal stamps, out-of-the-way stamps. Long sets, many new issues, etc. ABSOLUTELY FREE TO GENUINE APPROVAL APPLICANTS WHO SEND 2d. FOR POSTAGE. **J. BURTON, 31, ONSLOW ROAD, LIVERPOOL, 6.**

GET STAMPS THAT SATISFY!

We offer a conscientious service to Collectors, whether beginners, medium, advanced Collectors, or Specialists, and have always many outstanding bargains available. In your own interests write for our **Free Lists.** The Advertisement Manager of the "M.M." writes: "Throughout the very lengthy period you have been advertising in the "M.M." we have never heard a grumble, much less a complaint, against you." If you are looking for **sound Stamps at low prices, good service, prompt attention and courtesy,** notify your requirements to **NORRIS & CO. (Dept. M.), Norwood, London, S.E.19.**

"DIAMONDS"

MANY RARE STAMPS have been found by purchasers of **The "DIAMOND" Packet.** which contains approximately **1,000 UNSORTED STAMPS** from Convents abroad.

1 pkt. 1/3. 3 pkts. 3/6. 5 pkts. 5/6. All post free. (Abroad 3d. per pkt. extra.)

O. NERUSH

(Dept. K), 68, TURNPIKE LANE, LONDON, N.8, ENGLAND.

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Stamps you want on approval at prices guaranteed to astonish. Thousands of attractive stamps at ⅛th cat. Finest "space-filler" sheets and books of good class. Mention interests. Genuine bargains, no gifts!

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100 DIFFERENT STAMPS FREE to applicants for ½d. approvals.—Cox, 21, Dennis Mansions, Westcliff.

Air Mail Stamps on approval. Cheapest obtainable. N. R. Ensor, 7a, Southbourne Grove, Bournemouth.

FREE! Pk. of Mint Br. Col. Picts. Request Appros.—Shakeshaft, "Homeleigh," South Rd., Preston, Brighton.

Surprise Gifts to applicants. Farthing approvals average 1/6th Cat.—Hardman, 17, Hartington St., Belfast.

KINGS' HEADS, Colonial and Foreign Duplicates for disposal. One Farthing per stamp. Send postcard for trial.—Philatelist, 32, Josephine Av., Brixton, S.W.2.



Boys! Look! Famous "XLCR" Stamp Outfit is unbeatable value. Contains: Pair Tweezers, Watermark Detector, Pocket Wallet (Strip pockets), Perforation Gauge, Approval Book (120 spaces), 125 stamp hinges, 5 transparent envelopes. Price lists and a free gift set Pictorial Stamps (cat. 3d.). **All for 6½d.** Ask your shop to write to **THOMAS CLIFFE, COLWYN BAY.**

I WILL SEND YOU 1,000 DIFFERENT STAMPS

on approval, from which you may select any 100 for 3/-. These Stamps are **EXCELLENT VALUE** and include some catalogued at 1/- each or more.

MORE ADVANCED Collectors are invited to send for better class selection on approval, priced at one-fifth to one-third Catalogue.

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Beautiful Pictorial Packet Free

to applicants for approvals including 2d. postage, etc. Contains scarce commemoratives of old Kings, Battles, Ships, Castles, etc.

You can also win free 200 Portugal and Colonies, by selling from our sheets, which show big discount off cat. Particulars enclosed with above. Price list free.

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AIR MAILS & WALLET FREE! A fine Pocket Wallet filled with Air Mails

Given free to applicants requesting approvals. Send 1½d. for postage.

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SUMMER BARGAINS

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Stamp Gossip

and Notes on New Issues



The Philippine Islands Olympiad

We illustrate this month two of the designs from the Philippine Islands Olympic Games issue, to which we referred in the May *"M.M."* The 2c.



shows a baseball scene and the 6c. a tennis player making a forehand drive.

Although the latter design is open to strong criticism as completely wrong in its conception of tennis action—it is a safe prophecy that neither a stroke such as this player has made nor a racket of this shape will be seen on the courts during the course of the tournament—the series is an interesting addition to the list of sports stamps.

An Air Mail Commemorative

Lithuania has issued a set of six air stamps as a memorial to the two Lithuanian aviators Darius and Girenas, who were killed on 17th July, 1933, during a trans-Atlantic flight from New York to Kovno, Lithuania. The airmen had covered 4,000 miles, and were less than 400 miles from Kovno when their machine crashed into a mountain side.

The 20c. and 60c. values bear portraits of the airmen, and the 1L., 3L., and 5L. stamps have allegorical designs. The remaining value, 40c., bears the most interesting design. This is horizontal in format, the centre space bearing a picture of the ill-fated monoplane flying low over Atlantic rollers. The picture is flanked by panels showing on the left side the eastern American seaboard, and on the right the western European coast.



A Public Franking Machine

A postal franking machine was installed at the G.P.O., Cairo, on 1st January, for public use. The machine is coin-operated, the insertion of the coin and the pressing of a button releasing the franking mechanism as the letter is fed into the chute leading to the post box. At present the machine is available only for use with internal correspondence, but shortly similar facilities will be provided for foreign mail.

Sierra Leone Wilberforce Issue

Some of the more obscure details in the designs of the Sierra Leone Wilberforce commemorative issue, illustrated in the *"M.M."* in January and June last, are explained in a recent official advice from the Freetown Post Office.

In the ½d. value, the device spanning the central panel at the bottom consists of a dove and an olive branch, and the large cross shown in the side panels in the 1d. stamp is the Cross of Redemption.

The unusual border of the 4d. value was inspired by, and in fact is copied from, the gateway of the Old Colonial Hospital at Freetown, which stands on the site of an old slave yard. The inclusion of an elephant in the design of the 5/– value is really a delicate compliment to the Governor of the Colony, Sir Arnold Hodson, who has achieved considerable fame as a big game shot and elephant hunter.

In our note on the issue in the January *"M.M."* we referred to the figures in the panels flanking the portrait of King George on the 10/– value as being troopers of the Royal West African Frontier Force. That is true of the figure in the left-hand panel, but that in the right-hand panel is a Native Policeman.

Maryland's Tercentenary

We illustrate here an American stamp that holds a particularly strong interest for British collectors. It commemorates the tercentenary of the foundation of the settlement at Maryland, and the design shows the two small sailing vessels, the *"Ark"* and the *"Dove,"* in which the immigrants made their perilous voyage from England. The arms of the State of Maryland are shown in the background to the right of the stamp.



Irish Jubilee Issue

As though to confound the rumours that the Irish Free State had turned its back on commemorative stamp issues, a 2d. green stamp is to appear almost immediately to celebrate the Jubilee of the Gaelic Athletic Association. The G.A.A. is rather more than a simple sporting body. When it was founded in 1884 one of its avowed objects was to foster public interest in sports and games of a purely Irish origin. In recent years it has enjoyed almost a semi-official status in its effort to preserve the traditions and spirit of these games.

We thank Stanley Gibbons Ltd. for their courtesy in loaning the stamps from which the illustrations for our stamp pages have been made.

St. Helena Centenary Issue

This year St. Helena celebrates the completion of its first century as a British Crown Colony, and the celebration has been marked by the production of a really beautiful issue of stamps that deserves a



place in every stamp album. There are 10 stamps in the series, ranging from ½d. to 10/– in value; and of these we illustrate three, the ½d., 1½d. and 2d. values.

The ½d. stamp shows two famous peaks, known as Lot and Lot's Wife, that are situated in the southern part of the island. These peaks are of no great height, but even the skilled mountaineer will find them a severe test for his nerve and resource. Lot stands 1,444 ft. above sea level, and its pinnacle has a base diameter of only 100 ft. with a height of 290 ft.! Lot's Wife is not quite so slender, but even here the pinnacle's base diameter is considerably less than its height.

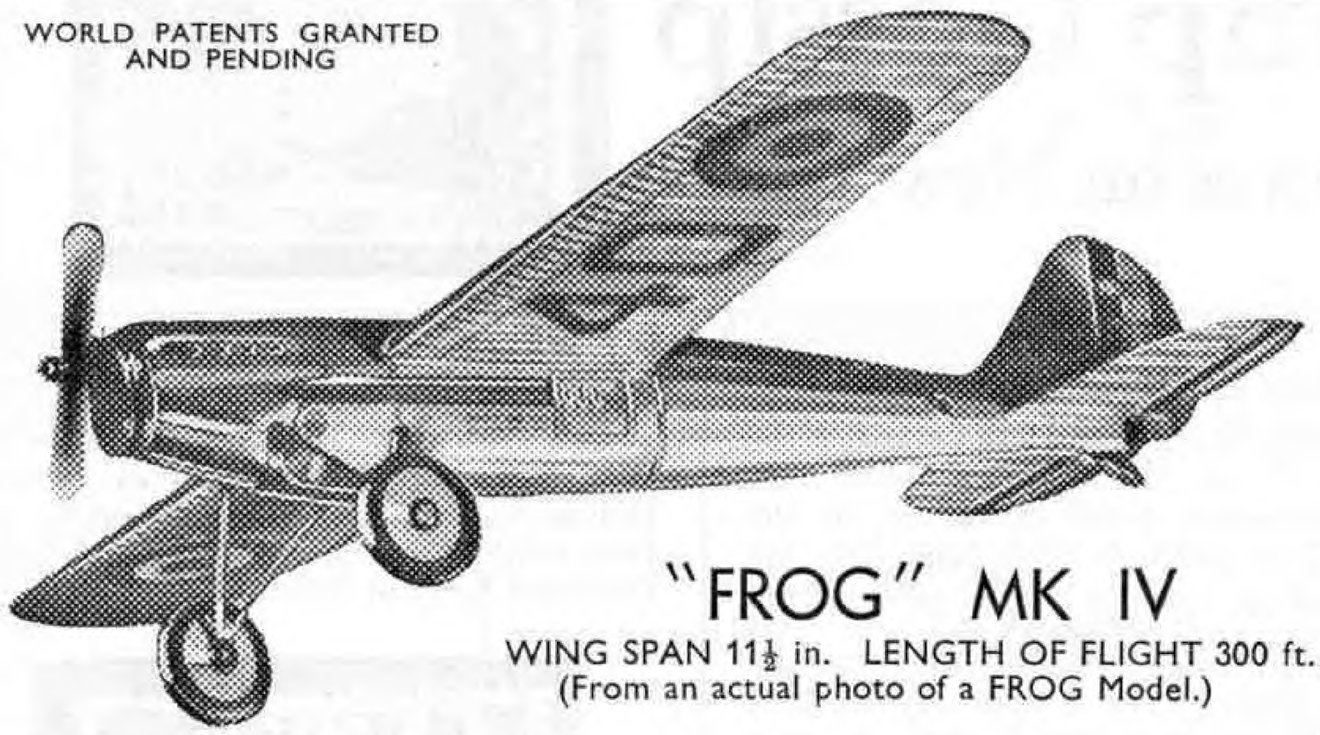
The 1½d. value shows an outline map of the island with all the principal places of interest named. The 2d. stamp is the best produced stamp of the series. It shows a view of the quay at Jamestown, and seems to exude the atmosphere of the quayside.

Possibly the most interesting feature of the issue is the deft manner in which the designer has incorporated in five of the stamps portraits of the four monarchs who have reigned since St. Helena accepted Crown Colony status, William IV, Queen Victoria, Edward VII, and King George.

There is not space here to describe the remaining stamps in detail. Briefly, the subjects of their designs are as follows: 1d., The Plantation, the official residence of the Governor. It is said that when Napoleon first came to St. Helena he was imprisoned in a cave in the grounds of the Plantation. 3d., James Valley and the upper part of Jamestown; 6d., another view of Jamestown; 1/–, Mundens Promontory; 2/6, St. Helena, Mother of Constantine the Great. The island derives its name from its discovery by the Portuguese on the anniversary of St. Helena's birthday. 5/–, High Knoll, a hill 1,900 ft. in height, lying to the south of Jamestown. The white building on its summit was used as a compound for Boer prisoners during the South African War. 10/–, the Emblem of the Colony.

FROG *FLYING SCALE MODEL* AIRCRAFT

WORLD PATENTS GRANTED AND PENDING



The original and now famous model. A scale model of a high-speed Monoplane. Tubular construction, patented quick detachable fittings. High efficiency air-screw. A splendid machine for realistic stunting. Watch it zoom, loop and "barrel roll." Made with the correct markings and in the full colours of seven nationalities. British R.A.F., Italy, France, Holland, U.S.A., Belgium and Argentine.

"FROG" MK IV

WING SPAN 11½ in. LENGTH OF FLIGHT 300 ft.
(From an actual photo of a FROG Model.)



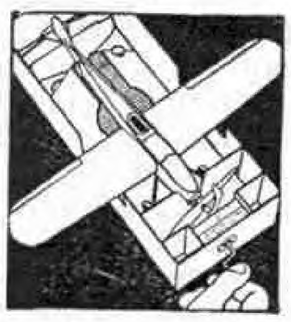
PRICE **7'6**

Complete with spare motors, lubricant and gear box oil, patent high-speed winder box and illustrated flying manual.

FROG TRADE MARK REGD.

Attractive coloured transfers of famous R.A.F. squadron markings for wings and fuselage. Easily applied.

1'6 per set.



From an actual photo of a FROG PUSS MOTH Model.

PUSS MOTH

WING SPAN 18 ins. LENGTH OF FLIGHT 600 ft.

A magnificent scale model of the famous record-breaking light aeroplane. All metal fuselage with bulkhead reinforcement, hollow wings of special design and construction. Dual motor coupled to gear box, glazed cabin and roof lights. "FROG" patent quick detachable fittings and high-speed mechanical winder. The model aeroplane "par excellence."

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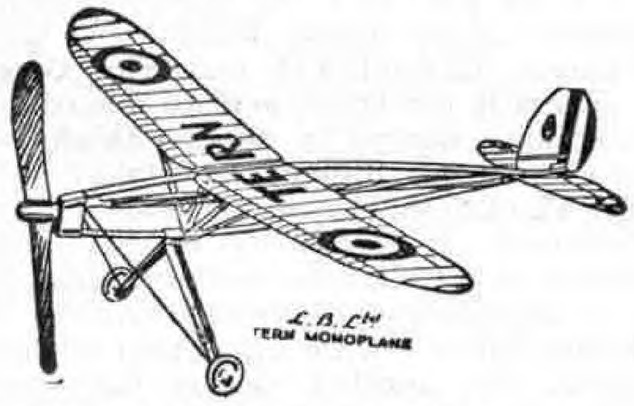
Complete with high-speed winder box, spare motor, inserter rod, gear box oil, elastic lubricant and illustrated flying manual.

The FROG AND PUSS MOTH can be quickly wound for flight with the patent high-speed winder box in which each model is packed.

Designed and Manufactured by International Model Aircraft Ltd.

Own a 'FROG' or a 'PUSS MOTH' and join the FROG FLYING CLUB. Membership free, write for particulars.

"TERN" MONOPLANE

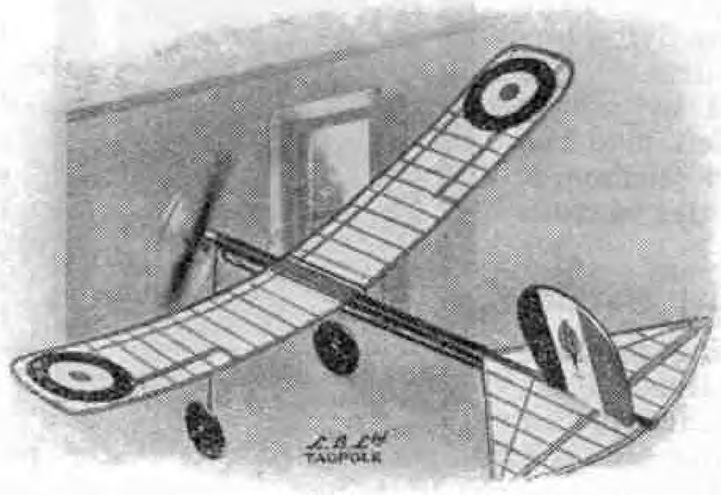


A splendid model for outdoor flying. Very durable construction. Wing Span 15 ins. Flies 200 ft. **1'6**

"TADPOLE" MONOPLANE FOR INDOOR FLYING

This is the amazing new model for indoor flying. It will rise off the floor or table or even off its own box, and fly round any room—large or small. Marvellous flights—no skill required—**quickly wound with its patented High-Speed Winder Box.**

NOT A KIT OF PARTS.



Price **2'6**

Complete with Patent High-Speed Winder Box.

WING SPAN 8 ins.

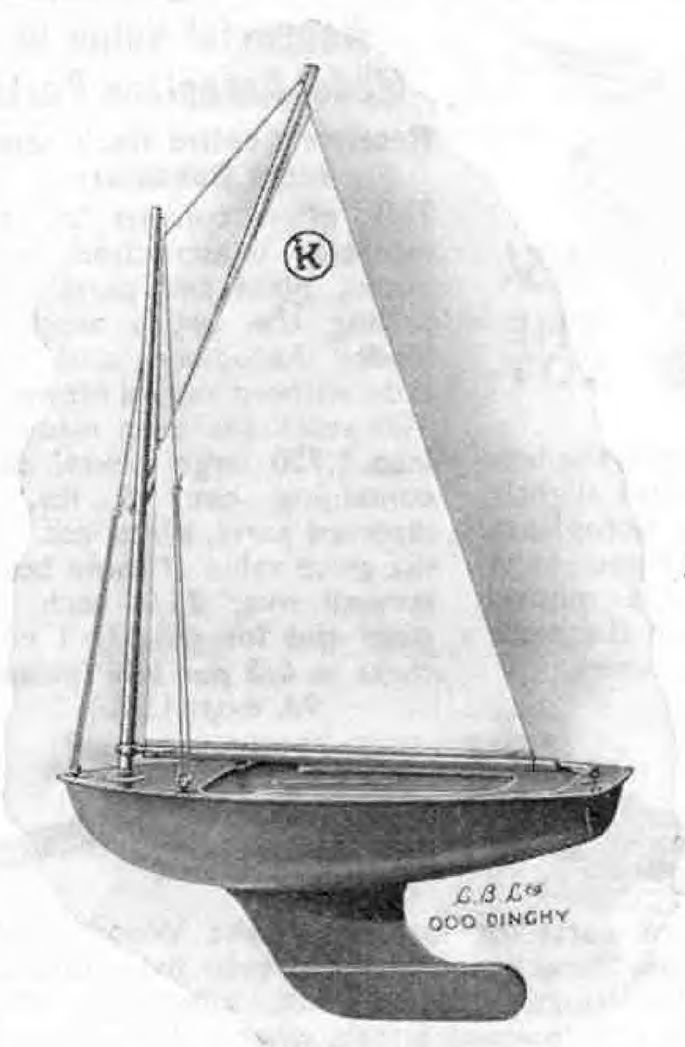
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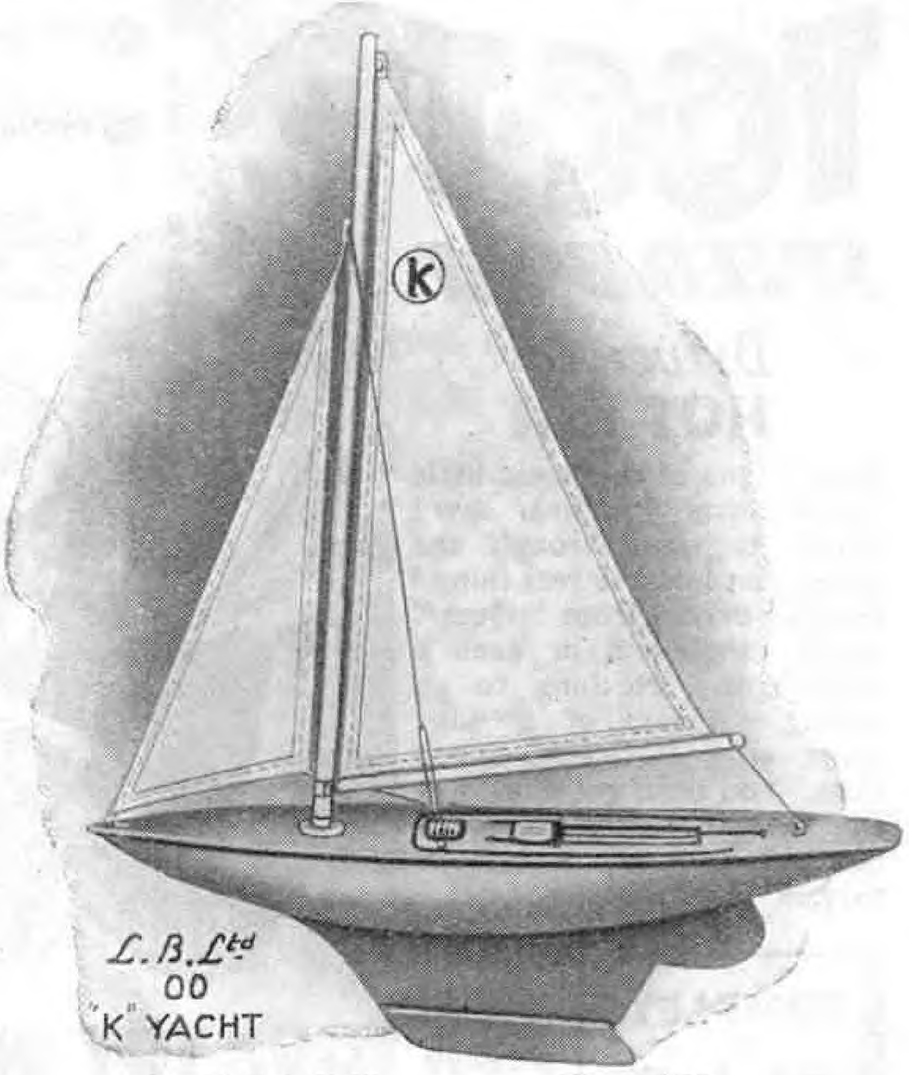
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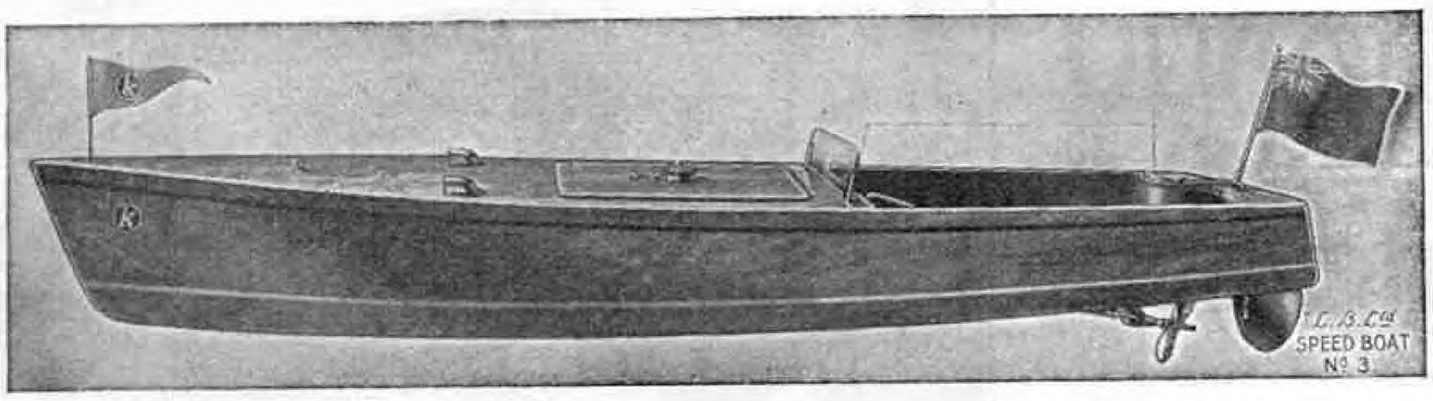
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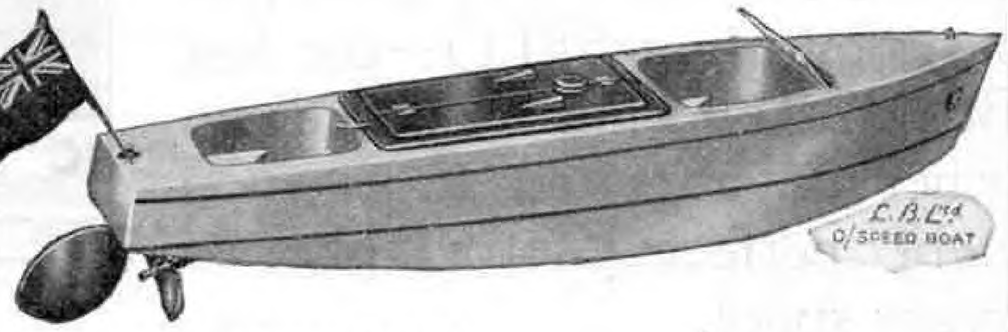
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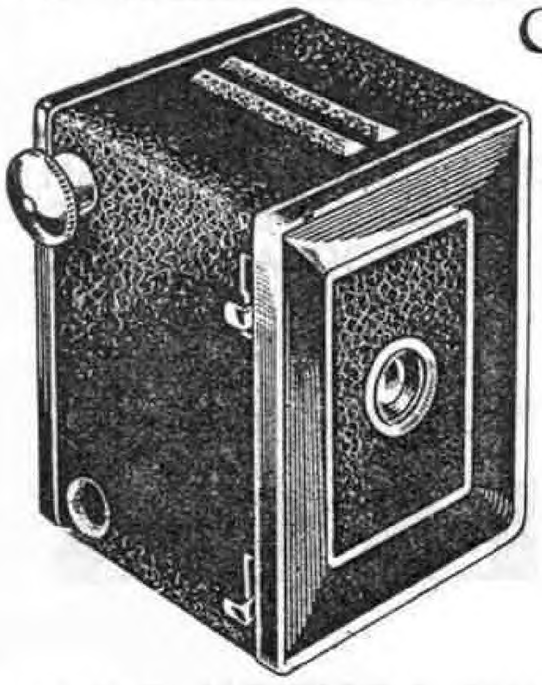
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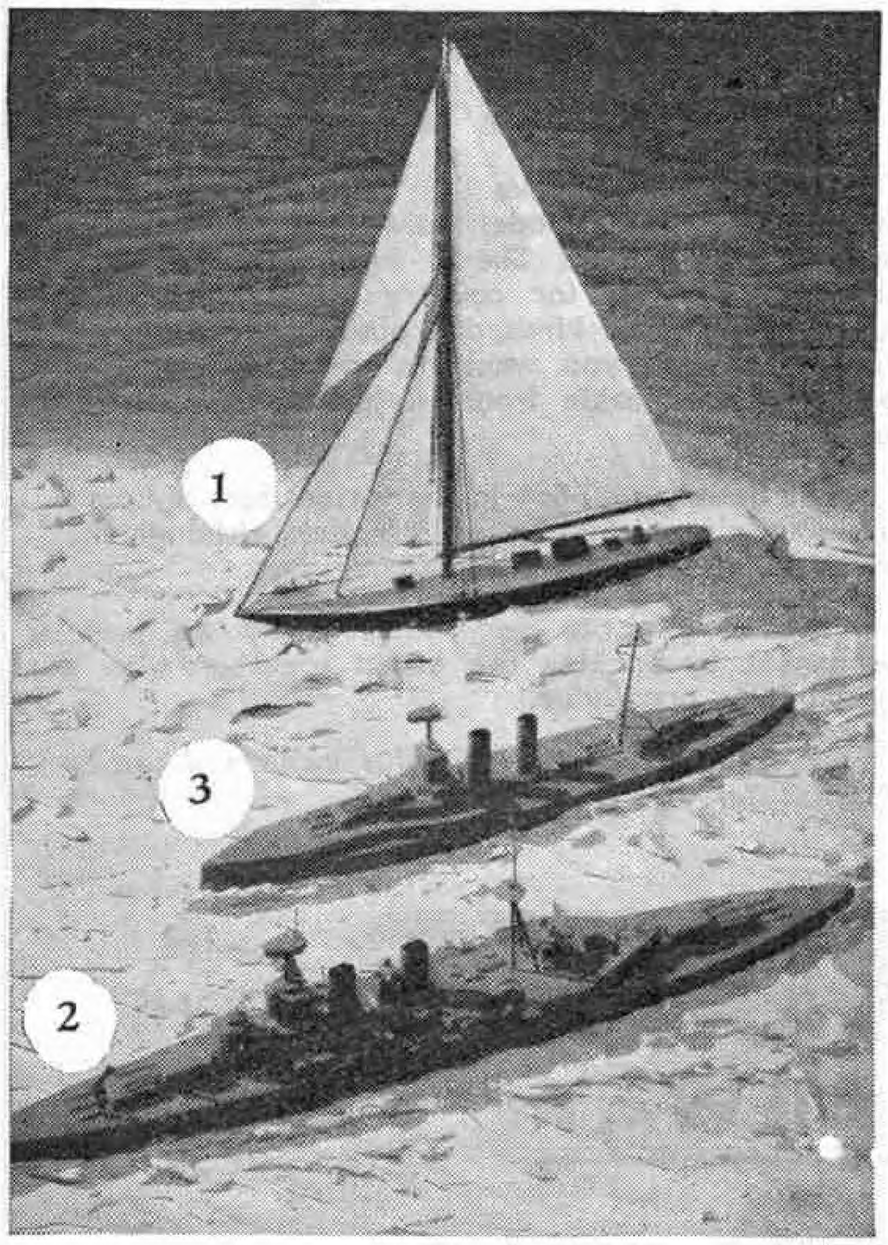


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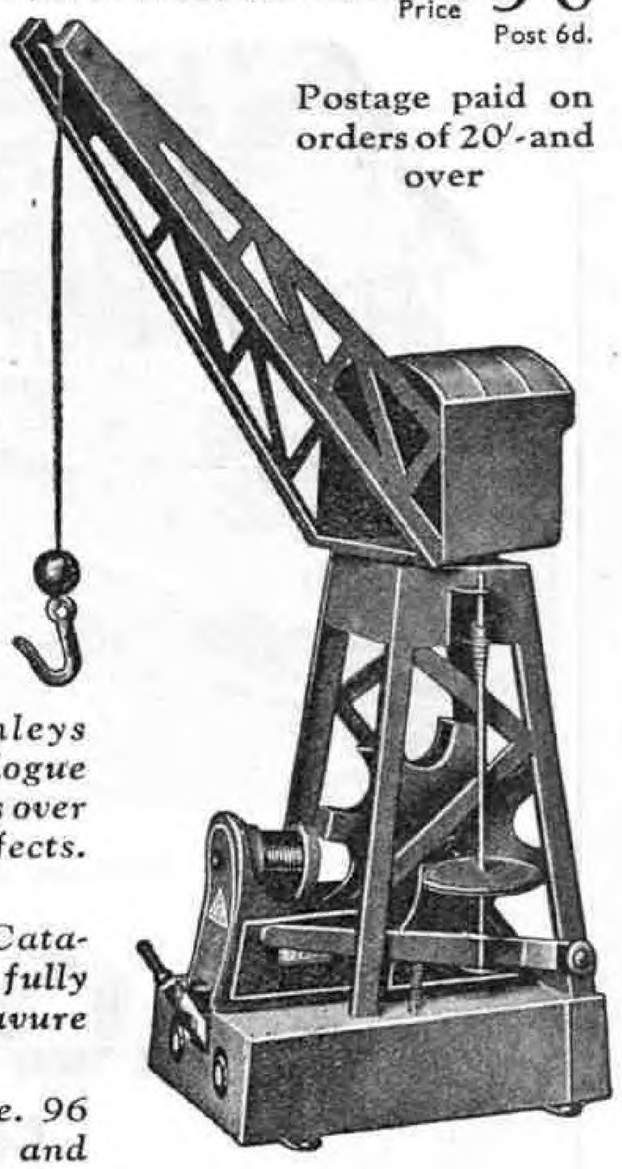
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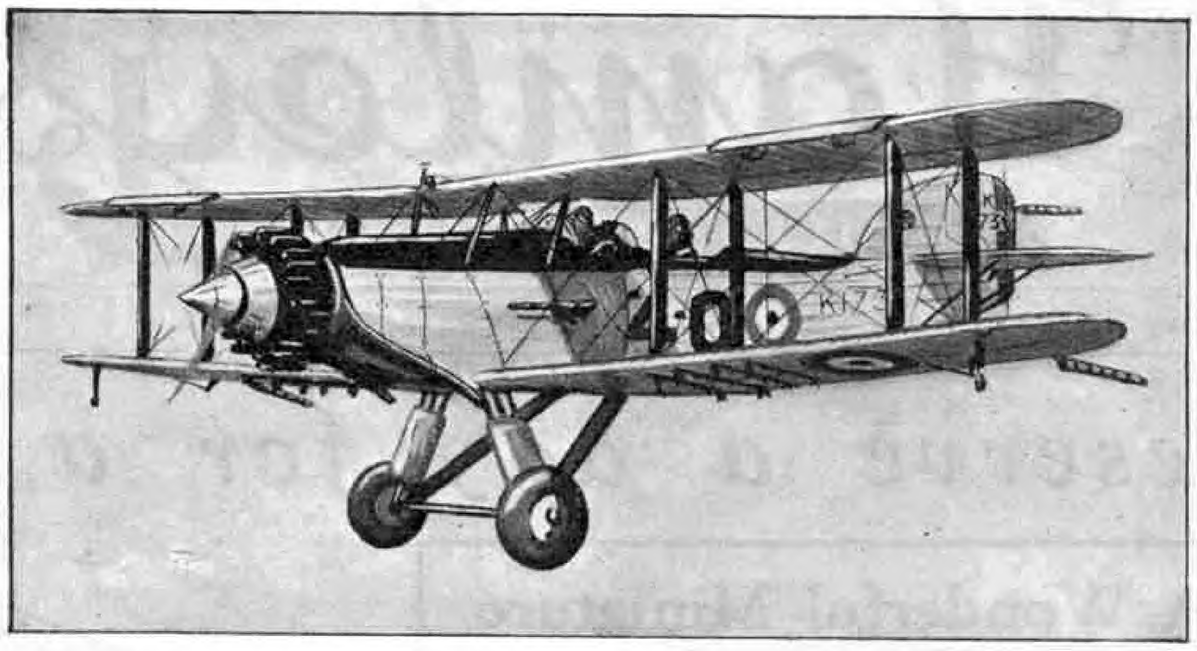
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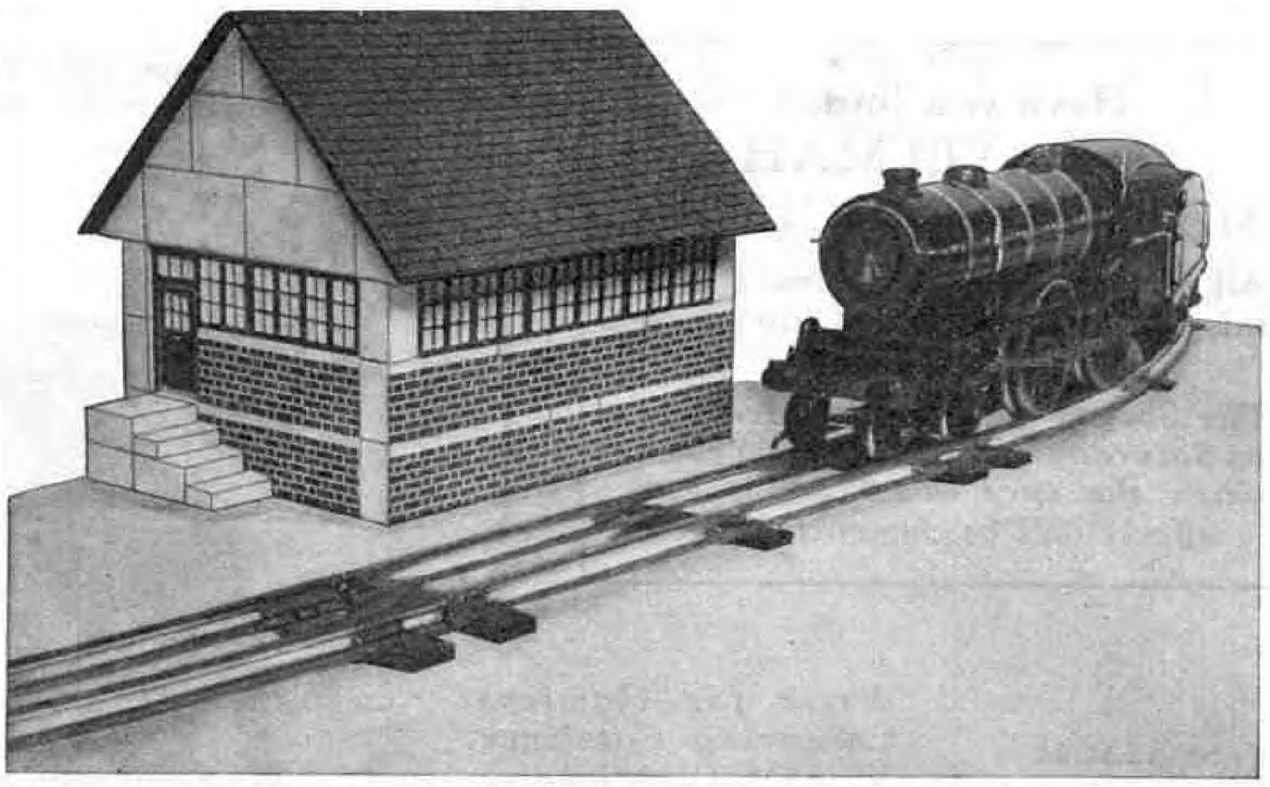
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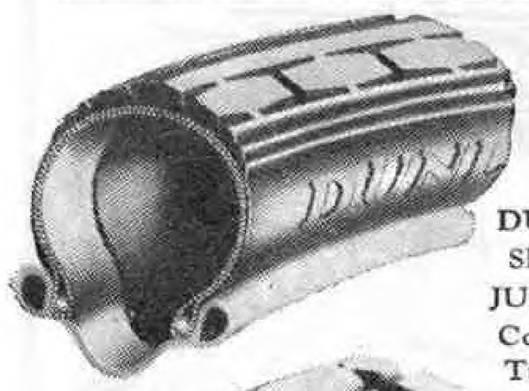
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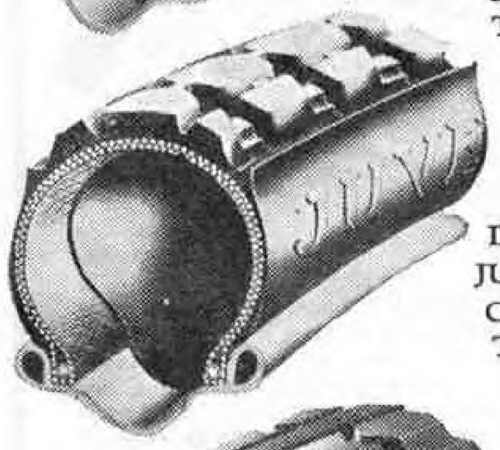
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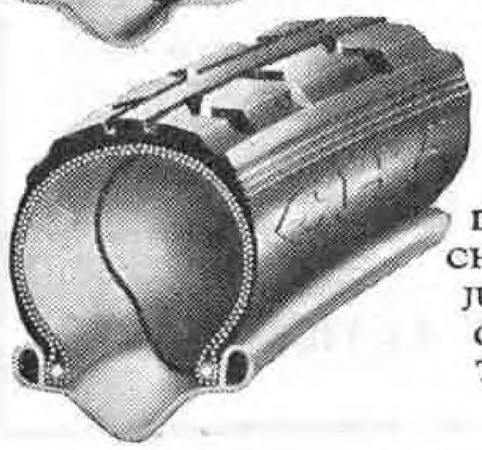
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Tube 2/3



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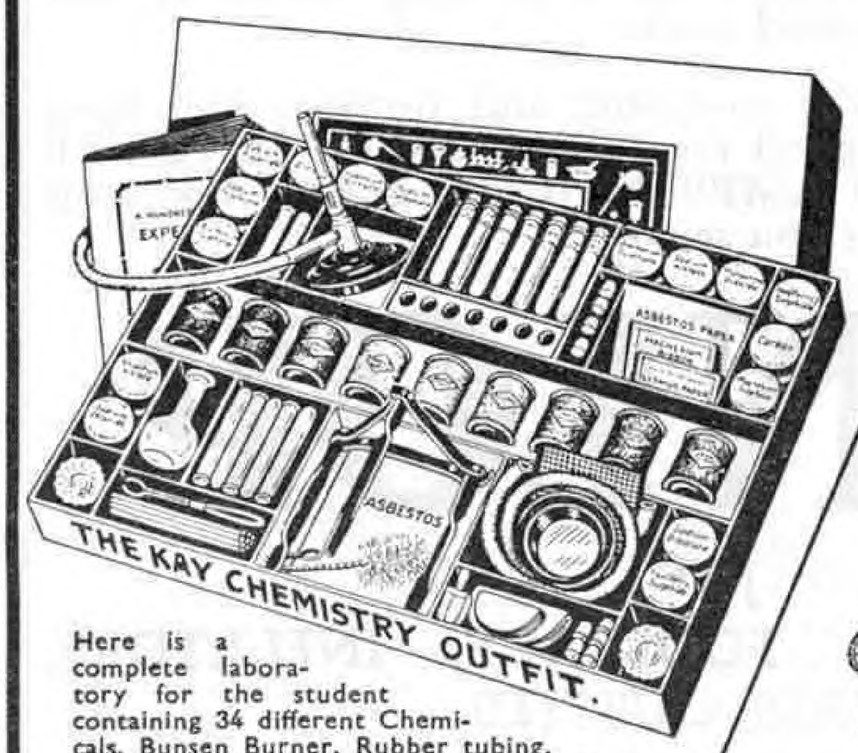
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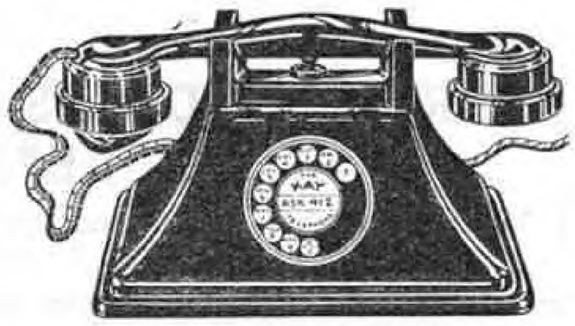
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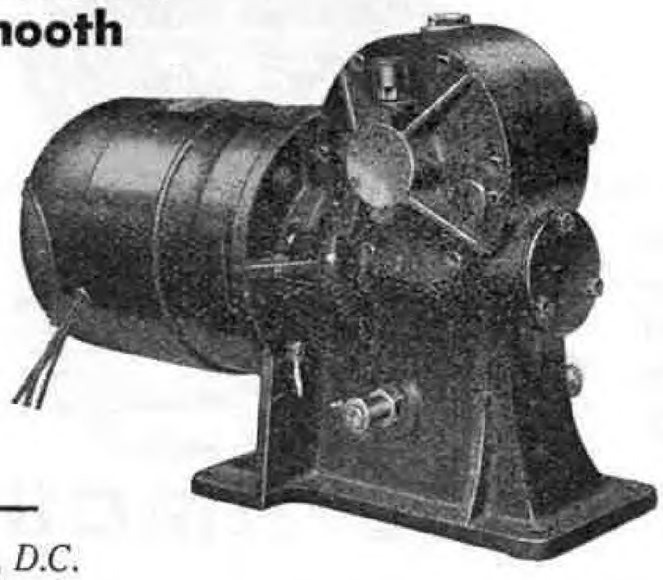
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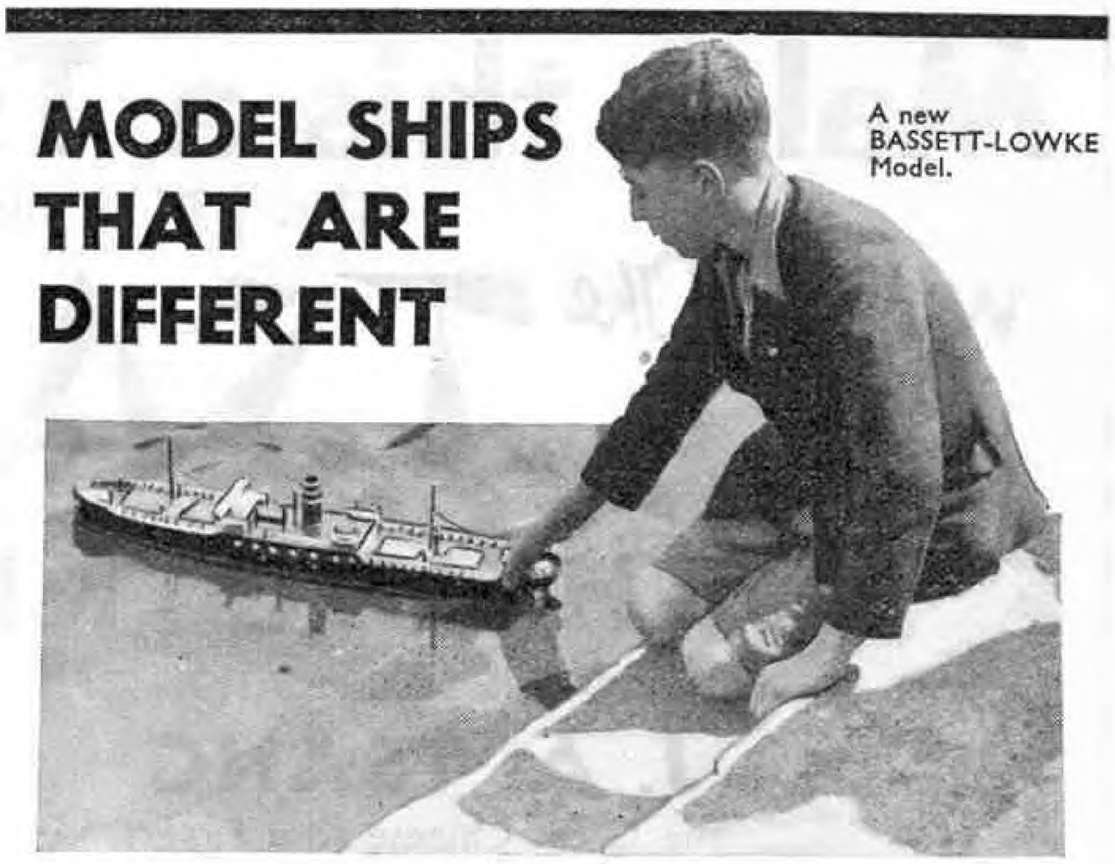
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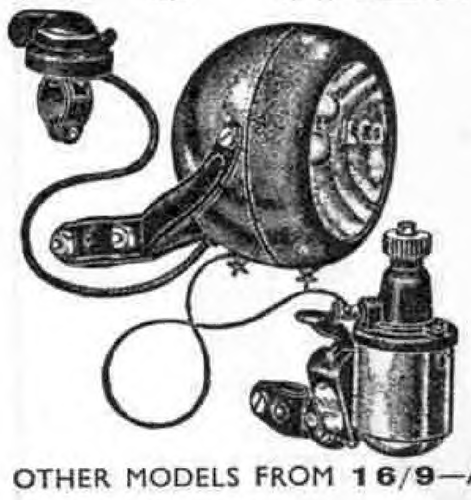
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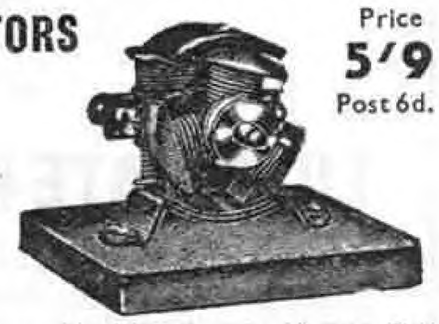
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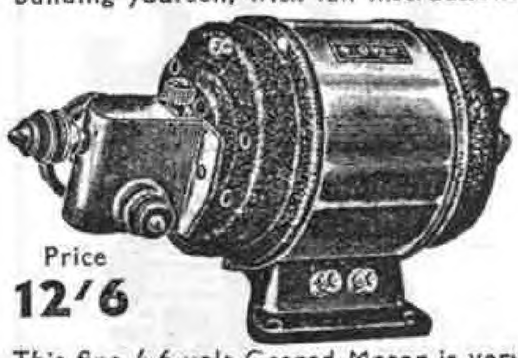
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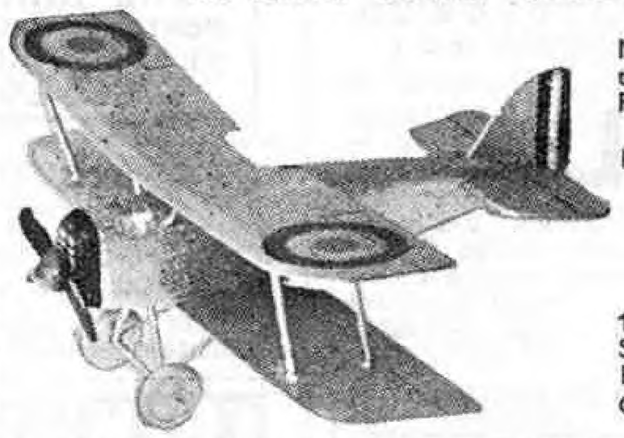
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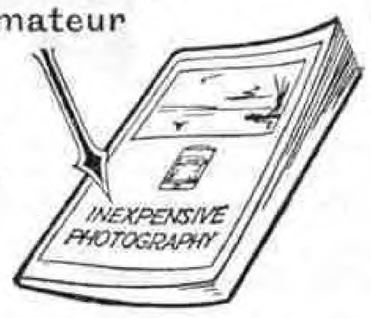
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Modern Locomotive Performance in Germany.
Train Timing and the Ways of Stop Watches.
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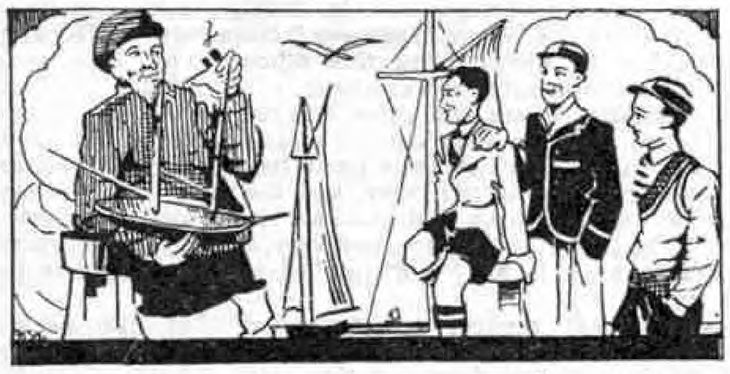
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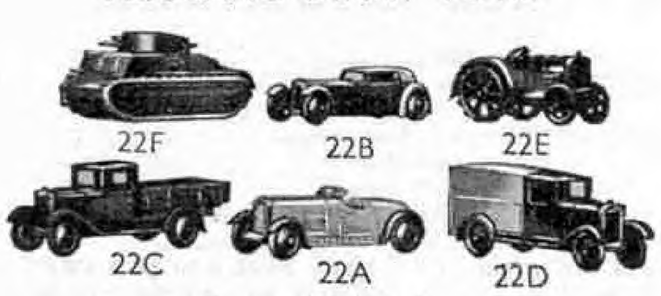


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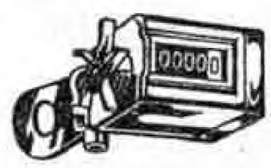
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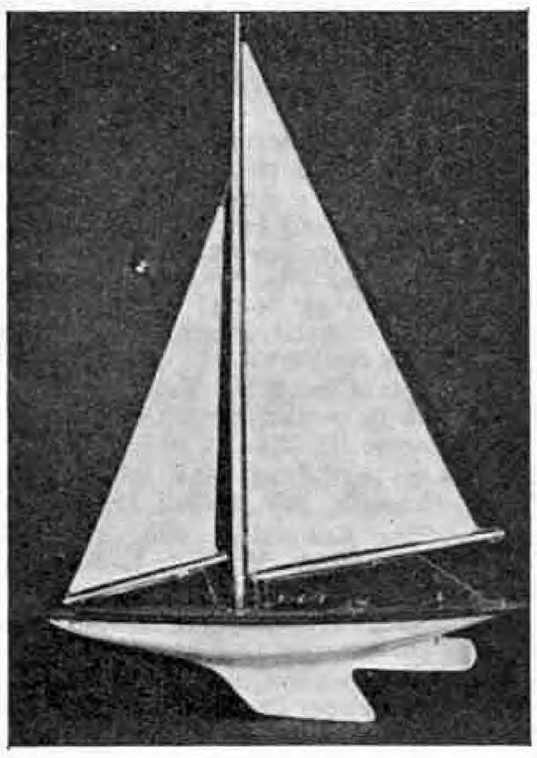
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Meccano Magazines, March 1927—July 1934. Excellent condition, none missing. What offers! Hewes, 52, Portchester Road, Portsmouth, Hants.

The World's Largest Dam—(*Cont. from page 607*)

The girders carried the loaded wagons to the centre part of the tower, where their contents were discharged into electric hoists that lifted the material high and discharged it into chutes down which it passed into storage hoppers. It was withdrawn from the hoppers in regulated proportions and transferred through chutes into either of two concrete mixers each of 2 cu. yd. capacity. The mixed concrete was discharged from the mixers into skips that were carried upward by electric hoists and emptied into chutes down which the concrete flowed to the building site. The receiving hoppers and the distributing chutes were mounted in a frame that could be raised as the work proceeded.

When a certain amount of concreting had been placed, the tower was temporarily withdrawn from this work and utilised to mix mortar for the masons engaged in laying the stonework of the upstream face of the dam. Thus the erection of the inside and the outside of the structure was carried on simultaneously. This method had the further important advantage that auxiliary mortar mixers were unnecessary in the area within reach of the towers.

The upstream face ranges in thickness from 26 ft. at the level of the deepest foundations to 3 ft. at the crest of the dam. It is essential that this face should be watertight, and therefore the masonry was set with specially-mixed mortar.

Two sets of irrigation sluices, called the low-level and high-level sluices respectively, have been built into the dam. The low-level sluices total five and are 14 ft. high and 7 ft. wide; while the high-level sluices total eight and are 10 ft. high and 10½ ft. wide. The gates of the sluices are operated by electrically-driven gearing installed in chambers built within the dam.

A diversion channel to carry off flood water from the reservoir and return it to the river at a point below the dam has been cut through the knoll known as Ellis' Saddle. It is provided with a series of sluices built on a curved weir of 800 ft. radius and at a level 20 ft. below full reservoir level, or 26 ft. below the maximum water level in floods. There are 16 openings of 60 ft. span, and each is equipped with an electrically-operated gate weighing 50 tons and 20 ft. in height.

The chief feature of the new irrigation at the delta of the river is the construction of a canal 67 miles long, beginning at the Grand Anicut, that will supply 529 miles of branch canals and distributaries. Only 58 miles of the main canal has been constructed for the present, as it is thought that this may prove to be sufficient to utilise the full supply of water available.

We are indebted to the courtesy of Hadfields Ltd., Sheffield, and Stothert and Pitt Ltd., Bath, for the information contained in this article.

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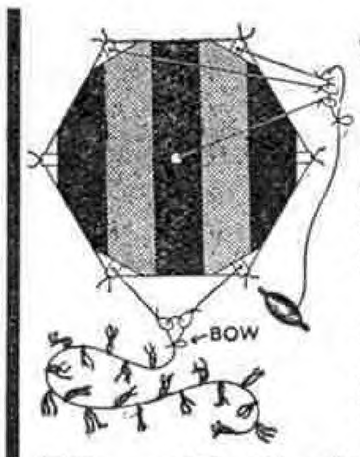
Railway Photographs, 23, Hanover St., Liverpool.

How an Aeroplane is Flown—(*C. from p. 623*)

that it should take him to fly between them, making due allowance for the speed and direction of the wind. He takes off and after he has been flying for the predetermined period of time and has made the necessary turns, he is almost certain to be over the desired spot, provided that the calculations were carefully worked out and the instruments obeyed during the flight.

Most of the instruments we have mentioned are shown in position in the drawing on page 623, which represents the interior of the cockpit of a General "Monospar." In this case the engine instruments are not included on the dashboard, as the "Monospar" is fitted with twin engines carried outboard on the wings, and the instruments are situated actually in the engine nacelles where they can easily be seen from the cabin. A feature of the type is that on both sides of the cockpit there are special windows that can be opened to give a forward view without admitting rain or cloud, an arrangement that makes the machine particularly valuable during bad weather.

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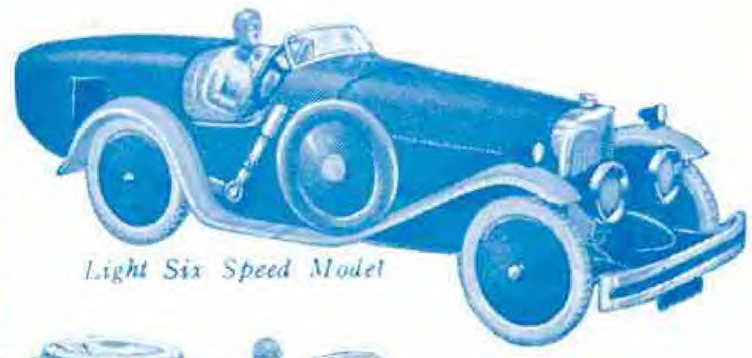
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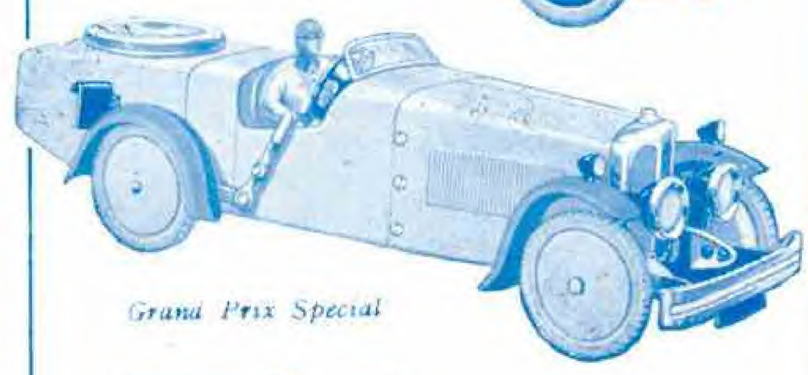
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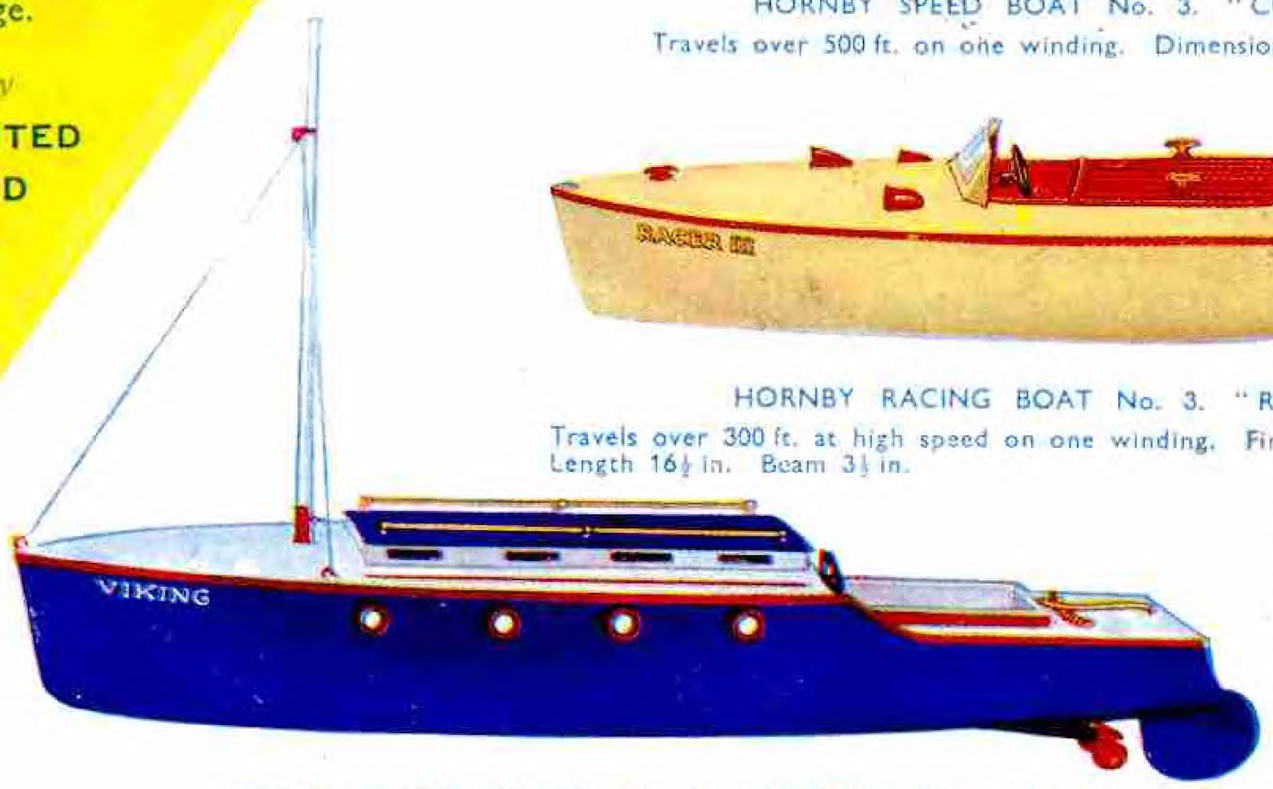
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HORNBY RACING BOAT No. 3. "RACER III." Price **14/6**
Travels over 300 ft. at high speed on one winding. Finished in Red and Cream. Dimensions: Length 16½ in. Beam 3½ in.



HORNBY CABIN CRUISER No. 5. "VIKING." Price **16/6**
Travels over 500 ft. on one winding. Dimensions: Length 16½ in. Beam 3½ in.

This is the Hornby Speed Boat Club Badge, which may be purchased from your dealer, price 6d. During Hornby Speed Boat Week it will be supplied free of charge by Meccano dealers to all purchasers of Hornby Speed Boats.



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